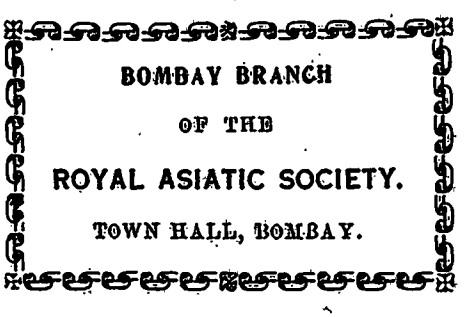
Agricultural Operations
in India, Review of
1923-24 to 1926-27

00134283



Digitized with financial assistance from

Government of Maharashtra

on 01 February, 2020

Review of Agricultural Operations in India

1923-24 to 1926-27

134283

00134283

PRINTED BY MANAGER
GOVERNMENT OF INDIA PRESS, CALCUTTA
1925

Government of India Publications are obtainable from the Government of India Central Publication Branch, 8, Hastings Street, Calcutta, and from the following Agents :—

EUROPE.

OFFICE OF THE HIGH COMMISSIONER FOR INDIA,
42, GROSVENOR GARDENS, LONDON, S.W. 1.

Constable & Co., 10, Orange Street, Leicester Square, London, W.C.
Kegan Paul, Trench, Trübner & Co., 68-74, Carter Lane, E.C., and 39, New Oxford Street, London, W.C.
Bernard Quaritch, 11, Grafton Street, New Bond Street, London, W.
P. S. King & Sons, 2 & 4, Great Smith Street, Westminster London, S.W.
Grindlay & Co., 54, Parliament Street, London. S.W.
Luzac & Co., 46, Great Russell Street, London, W.C.
W. Thacker & Co., 2, Creed Lane, London, E.C.
T. Fisher Unwin, Ltd., 1, Adelphi Terrace, London, W.C.
Wheldon and Wesley, Ltd., 2, 3 & 4, Arthur Street, New Oxford Street, London, W.C. 2.
East and West Ltd., 3, Victoria Street, London, S.W. 1.
B. H. Blackwell, 50 & 51, Broad Street, Oxford.
Deighton Bell & Co., Ltd., Cambridge.
Oliver and Boyd, Tweeddale Court, Edinburgh.
Ernest Leroux, 28, Rue Bonaparte, Paris.
Martinus Nijhoff, The Hague, Holland.
Otto Harrassowitz, Leipzig.
Friedländer und Sohn, Berlin.

INDIA AND CEYLON.

Provincial Book Depôts :

MADRAS :—Office of the Superintendent, Government Press, Mount Road, Madras.
BOMBAY :—Government Book Depôt, 1, Byramjee Jeejeebhai Road, Poona.
SIND :—Library attached to the Office of the Commissioner in Sind, Karachi.
BENGAL :—Office of the Bengal Secretariat Book Depôt, Writers' Buildings, Room No. I, Ground Floor, Calcutta.
UNITED PROVINCES OF AGRA AND OUDH :—Office of the Superintendent of Government Press, United Provinces of Agra and Oudh, Allahabad.
PUNJAB :—Office of the Government of Punjab, Lahore.
BURMA :—Office of the Superintendent, Government Printing, Burma, Rangoon.
CENTRAL PROVINCES AND BERAR :—Office of the Central Provinces Secretariat, Nagpur.
ASSAM :—Office of the Superintendent, Assam Secretariat Press.
BIHAR AND ORISSA :—Office of the Superintendent, Government Printing, Bihar and Orissa, P. O Gulzarbagh, Patna.
COORG :—Office of the Chief Commissioner of Coorg, Bangalore.
NORTH-WEST FRONTIER PROVINCE :—Government Press, Peshawar.

Thacker, Spink & Co., Calcutta and Simla.
W. Newman & Co., Ltd., Calcutta.
R. Cambray & Co., Calcutta.
S. K. Lahiri & Co., Calcutta.
The Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta, and 226, Nawabpur, Dacca.
Butterworth & Co. (India), Ltd., Calcutta.
Rai M. C. Sarcar Bahadur & Sons, 90-2A, Harrison Road, Calcutta.
The Weldon Library, 17, Park Street, Calcutta.
Standard Literature Company, Limited, Calcutta.
Association Press, Calcutta.
Chukervertty, Chatterjee & Co., Ltd., 13, College Square, Calcutta.
Higginbotham & Co., Madras.
V. Kalyanarama Iyer & Co., Madras.
P. R. Rama Iyer & Co., Madras.
Rochouse and Sons, Madras.
Bright & Co., Trivandrum.
V. S. Swaminathan, Bookseller, West Tower Street, Madura.
Thacker & Co., Ltd., Bombay.
D. B. Taraporevala, Sons & Co., Bombay.
Sunder Pandurang, Bombay.
Ram Chandra Govind & Sons, Kalbadevi, Bombay.
N. M. Tripathi & Co., Booksellers, Princess Street, Kalbadevi Road, Bombay.
Proprietor, New Kitabkhana, Poona.
The Manager, Oriental Book Supplying Agency, 15, Shukrawar, Poona City.
R. S. Gondhalekar's Book Depôt, Publisher and Bookseller, Budhwar Chawk, Poona City.
Managing Director, Co-operative Bookstall, Booksellers and Publishers, Poona City.
The Standard Bookstall, Karachi, Rawalpindi, Murree, Lahore, Peshawar and Quetta.
Karsandas Narandas & Sons, Surat.
A. H. Wheeler & Co., Allahabad, Calcutta and Bombay.
N. B. Mathur, Supdt., Nazir Kanun Hind Press, Allahabad.
The North India Christian Tract and Book Society, 18, Clive Road, Allahabad.
Ram Dayal Agarwala, 184, Katra, Allahabad.
Manager, Newal Kishore Press, Lucknow.
The Upper India Publishing House, Ltd., 41, Aminabad Park, Lucknow.
Munshi Seeta Ram, Managing Proprietor, Indian Army Book Depôt, Juhi, Cawnpore.
Rai Sahib M. Gulab Singh & Sons, Mufid-i-Am Press, Lahore and Allahabad.
Rama Krishna & Sons, Booksellers, Anarkali, Lahore.
Puri Brothers, Booksellers and Publishers, Katcheri Road, Lahore.
Manager of the Imperial Book Depôt, 63, Chandni Chawk Street, Delhi.
Oxford Book and Stationery Company, Delhi.
Supdt., American Baptist Mission Press, Rangoon.
Proprietor, Rangoon Times Press, Rangoon.
The Modern Publishing House, Ltd., 30, Phayre Street, Rangoon.
The International Buddhist Book Depôt, Post Box No. 971, Rangoon.
Manager, the "Hitavada," Nagpur.
S. C. Talukdar, Proprietor, Students & Co., Cooch Behar.
Times of Ceylon Co., Ltd.
The Manager, Ceylon Observer, Colombo.
The Manager, The Indian Book Shop, Benares City.
B. C. Basak, Esq., Proprietor, Albert Library, Dacca.

PREFACE.

This publication reviews very briefly the activities of the Agricultural and Veterinary Departments in India. A short summary of the progress made by the co-operative movement as directly affecting agriculture is also given. The review being of the nature of an annual progress report deals with much that has received mention in previous years. Prominent among the features which receive special attention in the present review are the work of the Indian Central Cotton Committee, the trial on a field scale of the seedling sugarcanes bred at the All-India Sugarcane Station at Coimbatore in Madras, the organization now being slowly built up by the Imperial and Provincial Departments of Agriculture for the development of cattle-breeding and dairying, and the new lines of research work being carried out at the Veterinary Research Institute at Muktesar.

The material for the review is derived mainly from the Annual Reports of the Imperial and Provincial Departments of Agriculture.

D. CLOUSTON,
Offg. Agricultural Adviser to the Government of India.

PUSA,
The 28th February, 1925.

TABLE OF CONTENTS

PAGE

CHAPTER I. AGRICULTURAL CONDITIONS OF THE YEAR . . 1

CHAPTER II. ECONOMIC WORK ON CROPS—

I. Rice 3
II. Wheat 6
III. Cotton 8
IV. Sugarcane 22
V. Jute 27
VI. Other fibres 29
VII. Tobacco 30
VIII. Oil-seeds—
(1) Linseed 33
(2) Castor . . . . . *ib.*
(3) Sesamum . . . . . *ib.*
(4) Groundnut . . . . . *ib.*
(5) Coconuts 34
IX. Tea 35
X. Coffee 36
XI. Rubber . . . . . *ib.*
XII. Fruit 37
XIII. Fodder crops and grasses 39
XIV. Juar (*Sorghum*) 41
XV. Ragi (*Eleusine coracana*) 42
XVI. Potatoes . . . . . *ib.*
XVII. Beans and pulses 43

CHAPTER III. RESEARCH AND INVESTIGATION—

I. Soils—
Survey of soils 45
The "available" phosphate in calcareous soils . 46
Reclamation of saline lands . . . . . *ib.*
Buffer action of soils 47
Soil moisture . . . . . *ib.*
Movement of nitrates . . . . . *ib.*
II. Nitrogen fixation 48

PAGE

III. Manures and fertilizers—
Farmyard manure 49
Green-manuring . . . . . *ib.*
Sewage sludge 50
Organic manures 51
Nitrate of soda 52
Phosphates . . . . . *ib.*
Lime 53
IV. Sugarcane . . . . . *ib.*
V. Sugar-beet 54
VI. Animal nutrition . . . . . *ib.*
VII. Milk . . . . . *ib.*
VIII. Preparation of malt from sorghum . . . 55
IX. Alcohol from tamarind . . . . . *ib.*
X. Lathyrism . . . . . *ib.*
XI. Kala-azar 56
XII. Diseases of crops . . . . . *ib.*
XIII. Insect pests 59
XIV. Useful insects—
(1) Bees 60
(2) Lac . . . . . *ib.*
(3) Silkworms 61

CHAPTER IV. AGRICULTURAL ENGINEERING—
(1) Bombay 64
(2) United Provinces . . . . . *ib.*
(3) Punjab . . . . . *ib.*
(4) Burma . . . . . *ib.*
(5) Madras 65
(6) Mysore . . . . . *ib.*
(7) Travancore . . . . . *ib.*
(8) Baroda . . . . . *ib.*
(9) Motor tractors . . . . . *ib.*

CHAPTER V. DISTRICT WORK—
(1) Bombay 67
(2) Madras 68
(3) Bengal 69
(4) Bihar and Orissa . . . . . *ib.*
(5) United Provinces . . . . . *ib.*
(6) Punjab . . . . . *ib.*
(7) Central Provinces 70

PAGE

(8) Burma 70
(9) Assam 71
(10) North-West Frontier Province . . . . *ib.*
(11) Mysore . . . . . *ib.*
(12) Travancore . . . . . *ib.*
(13) Baroda . . . . . *ib.*
(14) Hyderabad . . . . . *ib.*
(15) Kashmir 72

CHAPTER VI. AGRICULTURAL EDUCATION—

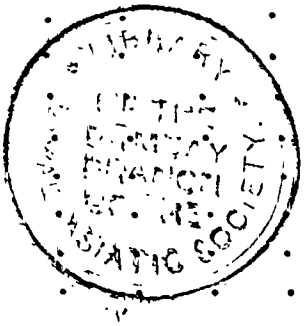
Higher Agricultural Education 73
(1) Poona . . . . . *ib.*
(2) Coimbatore . . . . . *ib.*
(3) Lyallpur 74
(4) Cawnpore . . . . . *ib.*
(5) Nagpur . . . . . *ib.*
(6) Mandalay 75
(7) Pusa . . . . . *ib.*
(8) Bangalore . . . . . *ib.*
Agricultural schools 76
Short courses 77

CHAPTER VII. THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE—

(1) Bombay 80
(2) Madras 81
(3) Bengal . . . . . *ib.*
(4) Punjab . . . . . *ib.*
(5) United Provinces 82
(6) Central Provinces . . . . . *ib.*
(7) Burma . . . . . *ib.*
(8) Bihar and Orissa . . . . . *ib.*
(9) Assam 83
Co-operative cotton sale societies . . . . . *ib.*
Co-operative milk societies . . . . . *ib.*
Cattle insurance 84

CHAPTER VIII. LIVE STOCK—

I. Prevention and treatment of disease . . . 85
II. Incidence of disease 86
III. Preventive inoculation 88
IV. Veterinary education 90
V. Veterinary research 92



PAGE

VI. Breeding—

(*a*) Cattle-breeding 94

(*b*) Sheep-breeding 99

CHAPTER IX. PUBLICATIONS OF THE AGRICULTURAL DEPARTMENTS—

(1) Imperial 101

(2) Provincial . . . . . *ib.*

CHAPTER X. RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL DEPARTMENTS 104

APPENDIX I. AREAS UNDER NEW AND IMPROVED VARIETIES OF CROPS DURING THE YEAR 1923-24 . . 107

,, II. LIST OF AGRICULTURAL STATIONS IN BRITISH INDIA IN 1923-24 111

,, III. TABLE SHOWING RESULTS OF WELL-BORING DURING 1923-24 122

,, IV. TABLE SHOWING THE NUMBER OF IMPROVED IMPLEMENTS SOLD THROUGH DEPARTMENTAL AGENCY DURING 1923-24 123

,, V. LIST OF AGRICULTURAL COLLEGES AND SCHOOLS IN BRITISH INDIA IN 1923-24 . 124

,, VI. OPERATIONS OF NON-CREDIT AGRICULTURAL CO-OPERATIVE SOCIETIES IN BRITISH INDIA DURING 1923-24 127

,, VII. TABLE SHOWING THE WORKING OF THE PROVINCIAL CIVIL VETERINARY DEPARTMENTS DURING 1923-24 131

,, VIII. TABLE SHOWING DETAILS AS TO STUDENTS OF VETERINARY COLLEGES AND SCHOOLS IN INDIA DURING 1923-24 132

,, IX. TABLE SHOWING THE NUMBER OF CATTLE ISSUED FROM GOVERNMENT FARMS DURING 1923-24 133

,, X. LIST OF AGRICULTURAL PUBLICATIONS IN INDIA DURING 1923-24 134

MANDALAY AGRICULTURAL COLLEGE.

Review of Agricultural Operations in India 1923-24

CHAPTER I.

AGRICULTURAL CONDITIONS OF THE YEAR.

Though the monsoon of 1923 made a comparatively late start, the rainfall was about normal over the greater part of India. In Sind, the Madras Deccan, Gujarat and Bihar, it ranged from 23 per cent. to 43 per cent. below normal; while in Lower Burma and Malabar, it exceeded the normal by 15 and 20 per cent. respectively. The winter rains were unusually early and heavy in North-west India, but in Bengal and Bihar they fell far short of requirements and *rabi* crops suffered. An ideal combination of climatic conditions over a vast country with varying physical features cannot be expected; but taking India as a whole, the season can be described as having been good. Almost all the important crops, with the exception of sesamum and indigo, gave a moderately good outturn.

The general condition of the agricultural population, depending as it does primarily on good seasons, was satisfactory. Prices of farm produce were good, and the prices of imported goods dropped slightly. The economic situation generally was thus favourable for the cultivator throughout the year.

The year was also good for live stock; epidemics were less severe, and the mortality was lower than in the preceding year. The fodder supply was normal over the greater part of India.

CHAPTER II.

ECONOMIC WORK ON CROPS.

The Imperial and Provincial Departments of Agriculture have, during the last 20 years, devoted much time to the study of the numerous varieties of the staple crops grown in India. The different varieties of each crop have been isolated, and tested with a view to getting types suitable for local soil and climatic conditions. When difficulty in getting suitable types by suitable selection was experienced, entirely new types were evolved by cross-breeding. The success of this line of work was almost immediate. The improvement effected was one which appealed to the cultivator as its adoption did not involve any material increase in his expenditure. The area under improved varieties has increased within the relatively short period of 18 years from a few thousands to millions of acres. The success achieved is indicated in Appendix I, from which it will appear that during the year under review there were over five million acres under improved varieties of crops originally isolated or evolved by officers of the Agricultural Department :—

Crop.	Acres.
Rice	603,603
Wheat	1,398,885
Sugarcane	50,604
Cotton	2,348,882
Jute	210,262
Other crops	467,146
TOTAL	5,079,382

If Rs. 10 per acre—a very conservative figure—be taken as the additional profit made from the adoption of these varieties, it is estimated that the annual value of the agricultural crops of the country has been enhanced by over five crores of rupees or £3½ millions sterling.

This must be accepted as only a beginning, but it opens up a vista of great possibilities for the future. The good work already accomplished has won the confidence of the cultivator, and paved the way for a further advance.

I. Rice.

Rice is the premier crop of India both as regards area and the value of its outturn. On an average it occupies nearly 35 per cent. of the total cultivated area, and is the staple food of most of the people of this country. None of the other staple crops of India are affected to such an extent as rice by the amount and distribution of the rainfall. Rice is, as a rule, less affected by the former than by the latter; an early cessation of the rains spells disaster for the crop on all except irrigated lands. As a result of the weakness of the monsoon in North-east India, the area under the crop shrank to 78,227,000 acres; in the preceding year it amounted to 82,401,000 acres. The acreage outturn was also less this year; for while there was a reduction of only 5 per cent. in area, the crop of 28,298,000 tons harvested was only 84 per cent. of the total yield for 1922-23.

In BENGAL, rice occupies over 20 million acres, or 70 per cent. of the cropped area of the province, and 26 per cent. of the total acreage under the crop in India. As usual, rice investigations continued to occupy the greater part of the time of the Economic Botanist and his staff. The large number of types under cultivation, and the widely varying conditions of climate and soil, make the work particularly complex in this province. As a result of many years of patient work, however, several superior varieties have been isolated, tested and propagated for distribution. In Indrasail and Dudshar, the transplanted *amans*, and in Kataktara, the high-land broadcast *aus*, the department has varieties which have been widely distributed and are doing very well in certain tracts; these are now supposed to occupy an area of approximately 150,000 acres. The crosses between early and late *aus* and between *aus* and *aman* varieties have been carried to a further generation.

Types have in this way been obtained which flower and ripen two to three weeks earlier than the earliest pure line *aman* types previously known and tested by the department—a result difficult, if not impossible, to obtain by simple selection. Work on deep water paddies has progressed to the extent that out of 786 types under observation a few heavy-yielding strains have been selected; but owing to the complexity of the problem, which is primarily one of flood-resistance, early results cannot be expected.

The germinative power of rice grains harvested at different dates after flowering is also being tested: the observations made up to date indicate that seed with a full germinating capacity can be obtained by harvesting the crop about 20 days after flowering.

In MADRAS, as in Bengal, rice is the main crop dealt with by the Economic Botanist. The work in hand includes the multiplication and trial of improved strains of paddy by selection, and the study of inheritance of characters along Mendelian lines. The latter investigation is especially useful where strains have to be selected to suit special localities and markets. It has been found, for example, that the Tanjore Sirumani type of grain is a simple dominant over the Anaikomban long type, which should make it possible to produce a Sirumani type of grain for distribution in the Tanjore District with a distinctive trade mark which would distinguish it easily from the bulk of paddy grown in that district.

In addition to the three pure strains, *viz.*, G. E. B. 24, Co. I and Co. II, which have already found favour with the ryots, the selection work at Coimbatore has yielded a fourth one, Co. III, which has been found to give a yield of 9 per cent. more grain than the standard variety with which it was compared. Two strains of Kuruvai, K. 18 and K. 74, have done well. Aduturai No. 1 has established itself, and Aduturai No. 2 also has been well reported on.

As the result of departmental propaganda, the method of economic planting is gradually coming into vogue, and the seed rate is being reduced.

As BURMA contributes three-fourths of the rice exported from this country, the requirements of the foreign market receive as much attention in this province as the increase of yield. The work on paddy is at present concentrated at Mandalay and Hmawbi. At the former station, 136 local varieties and 10 exotics obtained from Louisiana are being tried; the objects aimed at are the isolation of short-lived strains suitable for Mogoung areas, and the production of types to replace the older selections T. Ngasein and T. Taungdeikpan in irrigated tracts. For the latter, a promising selection has already been found in Ngayunwa. A white-rice strain has also been isolated from Ngathalun which, with its strong root system, is eminently suitable for stiff soils, but gives unfortunately a red rice which is useless for export. At Hmawbi the work is planned with a view to the isolation of slightly earlier types than the original selections of Ngasein 8 and Ngasein 10.

The pre-eminence of Sabour Dahia was maintained during the year under report in different parts of BIHAR AND ORISSA. It is not only valuable for poor early lands, but stands the deficiency of moisture better than the local varieties under similar circumstances. New varieties of the mid-season rices are not so well represented, but the late *aman* Kakharua is favourably reported on from several divisions and a selection from it, called Cuttack No. 2, has again beaten all varieties in the tests on the Cuttack farm.

Phosphate applied to rice land along with a green manure has given, in poor lands of South Bhagalpur, a net increased profit ranging from Rs. 10 to Rs. 50 per acre; this practice is being adopted by cultivators. At Kanke, the effect of 160 lb. per acre of ammonium sulphate on mid-season paddy grown on late but poor land was to increase the acreage yields of grain and straw from 1,512 lb. to 2,408 lb., and from 2,240 lb. to 4,480 lb. respectively.

In ASSAM, the medium types of rice selected are Georgesail, Latisail and Indrasail which, when tested against the local Chaprasail, gave increased yields of 472, 302 and 269 lb. per

acre respectively; of the finer varieties, Prosadhbhog and Nagrasail give higher yields than the local mixtures.

The application of bonemeal to rice continued to give highly satisfactory results in the Khasia and Jaintia hills. Spacing experiments indicate that seedlings transplanted from 6--9 inches apart, with two seedlings per hill, give the best acreage yields.

In the CENTRAL PROVINCES, an early rice has been isolated which will shortly be available for distribution. It ripens in a period of about 70 days and will be of particular value in areas where there are no facilities for irrigation. Some of the varieties selected some years ago by the department are now being grown on a large scale in the rice-producing districts.

In the BOMBAY PRESIDENCY, improved strains of rice are being produced at Larkana in Sind, at Karjat and Ratnagiri in the Konkan, and at Mugad in the Karnatak. The work, however, has progressed only at Karjat to the stage when seed of improved strains can be issued.

In the UNITED PROVINCES, varieties of rice imported from other rice-growing provinces having proved too late in ripening, attention is being concentrated on the improvement of local varieties which present a wide range of types. The work is still in the initial stage and will take some time to give definite results.

Halubbalu, a superior short season paddy, is becoming increasingly popular in the Malnad and semi-Malnad areas of MYSORE.

In TRAVANCORE STATE, work was mainly directed towards the study of various varieties and of the effect of different manures applied to rice lands.

II. Wheat.

Wheat which is the main food-crop of the people of Upper India is grown on about 10 per cent. of the total cultivated area of this country. The area is second only to that of rice. Owing to favourable early winter rains in North-west India, it rose from 30,844,000 acres in 1922-23 to 31,178,000 acres in 1923-24; but unfavourable climatic conditions at a later stage

reduced the estimated yield per acre by 24 lb., with the result that the local estimated outturn of 9,754,000 tons was 2 per cent. below the figure of the previous year.

The work done in evolving heavy-yielding, rust-resistant wheats of good milling and baking qualities, similar in class to Manitoba wheats and suitable both for internal consumption and export, is one of the finest achievements of the Agricultural Department in India. No variety of any other crop is so well known in India to-day as Pusa 4 or Pusa 12. These varieties are now being grown on a large scale in the United Provinces and the Punjab. They are making progress also in places so diverse as the Peshawar valley, North Sind, Kathiawar, the Nilgiri Hills, the Southern Shan States and the Simla Hills, and have made for themselves a home even in far distant Australia where they have at several agricultural shows carried off first prizes. The older selections from Pusa are not, however, quite acceptable in localities where the crop is liable to damage by animals and birds. A new series of bearded wheats have, therefore, been evolved, some of which have been found to compare well in yield with Pusa 12 and Pusa 4. Their milling and baking qualities are also reported to be very satisfactory.

In the PUNJAB, Punjab 11 still holds the field though the more recent selection 8A is reported to be a better yielder both on irrigated and unirrigated lands. The area under it was approximately eight lakhs of acres during the year under report; it is, however, being gradually replaced by the latter in certain tracts. Pusa 12 is popular in villages near Ferozepore and Panipat where wheat is irrigated from wells, while Pusa 4 is maintaining its supremacy on low-lying riverain lands.

Pusa 12, Pusa 4 and Cawnpore 13 wheats are so widely grown in the UNITED PROVINCES that it is no longer possible to estimate the area under them. As the demand for seed far exceeds the supply, Government has sanctioned the opening of 10 more seed stores, thus bringing the number for the province up to 100.

At Tarnab in the NORTH-WEST FRONTIER PROVINCE, Pusa 4 has so completely established its superiority that in the

Peshawar District very little of any other variety is now grown. The number of varieties under trial on the Government farms in this province was reduced to five, *viz.*, Pusa 4, Hard Federation, Punjab 11, Punjab 8A and Kanred from Kansas. At the time of harvest only the first two remained upstanding and free of rust; the others lodged badly.

Though a thorough trial of the cropping power of the Pusa and local wheats has not yet been made in BIHAR AND ORISSA, seed of Pusa 12 is being distributed in Patna and Saran Districts. Some of the new selections made at Pusa to suit the damp soils of the Tirhut Division in North Bihar were also given out during the year for trial.

In BOMBAY, Pusa 12 has proved particularly suitable for Sind and continues to give good results. Selection work on the local types at Jacobabad, however, indicates that certain strains of Phundani and Thoree may prove even more suitable than the Pusa variety. Similar work at Poona has also given some promising types which are likely to meet the needs of wheat-growing districts of the Deccan and Gujarat.

A selection of 25 types of wheat for rust-resistance has been made in BURMA. Federation and Pusa 4 continue to maintain their superiority in the Southern Shan States in black valley and red upland soils, respectively.

III. Cotton.

During the year the area under this crop rose to 23,088,000 acres from 21,792,000 acres in 1922-23. The average yield per acre was 88 lb. as compared with 93 lb. in the preceding year. The quantity of raw cotton exported during the year ending 31st March, 1924, was 3,008,000 bales, as against 2,690,000 bales of 500 lb. in 1922-23. The value of cotton goods exported was Rs. 1,095 lakhs.

Once again the Indian cotton crop has been extremely important in the world's markets. The American cotton crop of 1923, though it attained the large area of 38 million acres, only yielded 10 million bales (excluding linters) and a period of high prices was inevitable. Not only was the export demand

for Indian cotton keen, but English spinners' takings rose from 67,000 bales for the year ending July 1922 to 176,000 bales for 1923 and 257,000 bales for 1924, and we know that much of this was cotton of superior varieties on the establishment of which in suitable tracts the Agricultural Departments are concentrating. Unfortunately we have to record the fact that this unique opportunity of permanently establishing the better Indian cottons in the world's best market for staple cottons was partly spoilt by the export of adulterated and mixed cottons—a short-sighted policy which reduces the growers' profits and renders the Agricultural Departments' work doubly difficult. The American crop for 1924 has reached the record figure of 40 million acres and, with a favourable season, the present estimate of production is 13 million bales. Whether this level can be maintained is somewhat doubtful; but even if it can, the *world's* supply of cotton, especially of cotton of 1 inch to $1\frac{1}{8}$ inch staple, is too narrow and, as stated in last year's report, India has a great opportunity. High prices and a generally favourable monsoon have led to increased sowings of Indian cotton in 1924, the area recorded in the second forecast being 21,785,000 acres as compared to 17,788,000 acres in 1923.

THE INDIAN CENTRAL COTTON COMMITTEE has now completed its third year as an advisory body and its first since its incorporation with funds of its own under the Cotton Cess Act of 1923. It has continued to devote attention to the improvement of marketing and the checking of adulteration and malpractices.

The Cotton Transport Act has now been in force in the greater part of the long staple cotton areas of the Bombay Presidency for a year and trade opinion is unanimous that marked improvement has resulted in the quality and purity of Surat, Dharwar and Kumpta cottons in consequence, whilst the value to the cotton growers is shown by the enhanced prices paid for these cottons.

The cotton-growing areas of the Baroda State are much intermingled with those of the Gujarat Division of the Bombay Presidency. It is, therefore, a pleasure to record that the Baroda Durbar have passed a law on the lines of the Indian Cotton Transport Act and have notified zones corresponding

with those notified by the Government of Bombay. The prompt and hearty co-operation of the Baroda State in this, as in other matters connected with cotton improvement in Gujarat, is of the greatest assistance.

The question of applying the Act to Madras is still under consideration. In a recent communiqué the Government of Madras called for opinions (to reach them by 1st October, 1924) on the proposal of the Provincial Cotton Committee that the Act should be put into force in three zones, *viz.*, a Northerns and Westerns zone, a Cambodia zone and a Tinnevelly zone. The communiqué gives specific instances of existing abuses and stated that " these malpractices no doubt enable the dealer who indulges in them to obtain an immediate profit, but their inevitable result must be deterioration in the quality of the cotton crop and a heavy fall in price which will seriously affect the interests of the cotton grower."

Regulation of Gins and Presses. A Bill closely following the recommendation of the Indian Central Cotton Committee was introduced in the Legislative Assembly in September 1924 and circulated for opinion. It departs from the model suggested by the Committee in that no permissive clause has been included enabling Provincial Governments to introduce a system of licensing. The proposed measure is a necessary corollary to the Cotton Transport Act; its necessity was urged by the Indian Cotton Committee of 1917-18, and it is hoped that this important measure will soon find a place on the Statute book.

Cleaner Picking of Cotton. Reference was made last year to the alteration in their rules which the East India Cotton Association had made at the request of the Indian Central Cotton Committee to provide a definite incentive to the cleaner picking and marketing of cotton. The additional standards, giving effect to this decision, were introduced during the year under report, and there is every reason to believe that, though progress is necessarily gradual, this important step is having the desired effect.

Various Directors of Agriculture have supplied the Committee with some figures illustrating the additional cost to the

cultivator of the cleaner picking of *kapas*. This enquiry is not yet complete, but the general indication appears to be that where the premium necessary to induce cleaner picking amounts to about Rs. 16 per Bombay khandy (as in the case of Tinnevelly and Cambodia cottons) the present scale of " on " allowance would make cleaner picking profitable, even if the cotton were tendered against hedge contracts—the least favourable way of selling high grade cottons. Where, however, (as in the case of Northerns and Westerns) the principal factor is a material loss of weight of *kapas* and corresponding reduction in blow-room loss in the mill, the organization of direct sale to consumers is the obvious method to adopt. The success attained by the auction sale of graded *kapas* conducted by the Co-operative Cotton Sale Societies in the Kumpta-Dharwar (Hubli and Gadag) area in Bombay—which deal with cotton normally marketed in as dirty a condition as average Northerns and Westerns—indicates a way to the solution of this problem.

Increased use of Indian Cottons in Lancashire. As already mentioned, there has been a marked improvement in the takings of Indian cottons by Lancashire spinners and a marked increase of interest in Indian cottons. It would obviously be much to the advantage of the grower if the better Indian cottons could find a permanent footing in the Liverpool market, as this would undoubtedly stabilize the premiums for staple fluctuations which have presented grave difficulties to Agricultural Departments in the past.

The exhibit of Indian cottons which, at the request of the Government of India, the Central Cotton Committee organized at the British Empire Exhibition in 1924 aroused much interest and has undoubtedly done a great deal to spread the knowledge of India's position as a cotton producer. Probably never before has a fully representative collection of Indian cottons been exhibited in Lancashire. In its efforts to make Indian cottons better known the Committee has had the steady support of the Empire Cotton Growing Corporation, the Indian Sub-Committee of which organized a preliminary series of spinning trials on the Indian cottons most familiar to the Liverpool market. These trials were conducted through the Oldham

Master Cotton Spinners' Association. As a result the Committee have now furnished a representative set of eight of the new improved cottons which Agricultural Departments have introduced on a commercial scale. These will undergo further trials and the results will be made available to spinners generally. It is also interesting to record that there is every probability of the Liverpool Cotton Association establishing a new hedge contract for "outside growths," to supplement the existing American and Egyptian futures contracts. Special attention is being given to Empire grown cottons, and it is intended that the best of the Indian cottons should be tenderable against this contract. The importance of this in connection with the sale of Indian cottons not only in Great Britain but on the whole of the Continent is obvious.

If stress has been laid on the export aspect of Indian cotton production in the preceding paragraphs, it must not be assumed that the requirements of Indian mills which consume 2 million bales annually, out of an average crop of 5 million bales, are not being fully considered. Reference has been made in previous reports to the analysis of the Indian cotton supply contained in the Bulletin issued by the Committee which shows that the present margin of production of stapled cotton in India is too narrow. Any extension of Indian spinning, even if the present ratio between low and medium counts were preserved, would necessitate an enhanced supply of the longer stapled Indian cottons. There is an undoubted tendency for Indian mills to increase their production of the higher counts. The requirements of Indian mills would, therefore, appear to necessitate the production of the longer stapled Indian cottons being placed on a broader basis; in other words their requirements are not entirely dissimilar to those of the world's markets in general. An improved export demand for Indian stapled cottons would help to stabilize prices, and thus help to extend and stabilize production.

Cotton Research. The outstanding feature of the year's work, however, has been the progress made in putting into force the Committee's programme for research work, financed from the cotton cess. The Institute of Plant Industry at Indore,

the cost of which is being met partly by the Indian Central Cotton Committee, and partly by the Central Indian States (and for which the Committee has provided a capital grant of Rs. 2 lakhs and a recurring grant of Rs. 1 lakh), was sanctioned by the Government of India in March 1924. On their return from leave shortly after the close of the year under report, Mr. and Mrs. Howard joined the Institute as Director and Botanist respectively. The 300 acres of land provided by the Indore Durbar make an excellent site for the Institute and farm. This has been handed over, and the construction of the buildings and the laying out of the land have been started. Situated as it is in one of the largest homogeneous cotton-growing tracts in India, the work of the Institute will be of assistance to several Departments of Agriculture, and important results are looked for.

As stated in last year's report, the Committee are also financing special research schemes in the various provinces, *viz.*, investigations on cotton wilt, the causes of boll and bud shedding, the spotted bollworm in Bombay, the *herbaceum* constituent of Northerns cotton in Madras, and the pink bollworm in the United Provinces. They have also made grants to the Central Provinces Government which has enabled a full time Cotton Botanist to be appointed for the botanical study of the cottons of Berar and the Central Provinces with a view to the improvement of staple. They are also providing a special Cotton Botanist for the Punjab for the study of the special problems arising from the introduction of long staple cottons of the acclimatized American type under canal irrigation.

The Committee's Technological Laboratory in Bombay is now equipped and ready for work. The Experimental Spinning Laboratory was completed in July and during the year most of the equipment for the Research Laboratory has arrived. The latter is temporarily housed in the Victoria Jubilee Technical Institute where, through the courtesy of the Trustees, arrangements have been made for scientific work, pending the construction of the Committee's own main laboratory. Although it occurred after the end of the year under report,

reference must be made to the interesting ceremony of the 3rd, December, 1924, when His Excellency the Viceroy formally opened the Spinning Laboratory and laid the foundation-stone of the Research Laboratory. As His Excellency said on that occasion: "The spinning test represents the main avenue to all technological research in cotton; and the experimental spinning plant, erected here, now enables the most satisfactory method of ascertaining the value of cotton by actual spinning tests to be carried out under expert control. These tests will be supplemented by other scientific processes directed towards classifying the properties of various types of Indian cottons, and these results will be correlated with the results from spinning tests. * * * * * * * * * * * * I need not emphasize the great value of this work. Its effect in assisting the selection of the most suitable varieties of cotton for growing, and in placing facts before the producers and consumers of first importance in the marketing of cottons, cannot be over-estimated. I heartily congratulate all those concerned in the successful start made in technological research work here, and I also felicitate the public interested in cotton on the possession of an institution designed for scientific tests which, I am confident, will be of the greatest value in the history of this most important industry."

The BOMBAY Presidency, with an area of over five million acres of cotton, consists of five distinct cotton-growing tracts, four in the Presidency proper and one in Sind. In the Karnatak, cotton occupies 1½ million acres, chiefly in the districts of Dharwar, Bijapur and Belgaum, of which Kumpta cotton accounts for 1 million acres and Dharwar-American for about ½ million acres. The Director reports that the department's improved strain of Kumpta (Dharwar No. 1) was sown on an area of 75,000 acres, the net gain to the cultivator being estimated at Rs. 5 per acre. The improved type of Dharwar-American known as Gadag No. 1 is sown on 65,000 acres and the net gain to the cultivator estimated at Rs. 13 per acre. It is hoped to secure even more satisfactory results from new strains. A very promising hybrid between Kumpta and Roseum cottons has been obtained which combines a high

ginning percentage with a staple of 1 inch and good colour. The cross between Kumpta and a Burmese cotton (Wagale) may prove of great economic value as it shows signs of being wilt-resistant. In this area, the department controls the seed sown on over 5,000 acres of Kumpta cotton and on 5,000 acres of Gadag No. 1, seed being distributed through 38 depôts.

The work of the Co-operative Cotton Sale Societies is referred to in a subsequent chapter. It is, therefore, sufficient to say here that it is in this tract that they have made most progress.

In Gujarat, the introduction of the improved strain of Surat 1027 A.L.F. has been continued, and not only has the tract south of the Tapti now been practically cleared of shorter stapled cottons, but the whole of the area south of the Narbada now grows the A.L.F. variety extensively, the aim of the department being to establish one variety only throughout the whole tract south of the Narbada. The department now controls 9,000 acres of special seed farms producing $1\frac{3}{4}$ million lb. of seed.

North of the Narbada, work is still in a preliminary stage, one of the principal difficulties being that in this area a cotton of higher ginning percentage than the existing departmental strains appears to be essential if the short stapled types of Broach are to be ousted. A promising type which appears to combine staple length and high ginning percentage is now being multiplied on the Surat farm.

In the Dholleras tract, several pure types of Wagad cotton have been evolved and are now being multiplied at Viramgaon.

The South Gujarat and Karnatak areas represent the most important stapled cotton-growing tracts in the Presidency where considerable progress has been made in establishing improved types. The application of the Cotton Transport Act in these areas has already been referred to. In the Karnatak the rules framed by the Bombay Government under the Act appear to have worked very satisfactorily. In Surat minor adjustments have proved necessary. There is not the slightest doubt that the operation of the Act has already done great good by stop-

ping the importation of inferior cotton into certain areas whose cotton was losing its identity owing to wholesale mixing. This is now being stopped to the great benefit of the growers of superior cotton as is evidenced by the rise in the margin between, for example, Navsari and Broach cottons which has increased from Rs. 100 to 150 per khandy.

In Khandesh, which is the short staple cotton area of the Presidency proper, seed distribution has been limited to the N. R. type. A hybrid between Bani (*G. indicum*) and Comilla (*G. cernuum*) cottons shows great promise.

In Sind, the prospect of perennial irrigation on the completion of the Lloyd Barrage canal scheme has enabled the policy in regard to cotton growing to be entirely revised, and there seems every probability that this will become one of the most important stapled cotton tracts in India. The policy to be followed in regard to the investigation of the many special problems that arise has recently been thoroughly reviewed by a Committee appointed by the Government of Bombay.

In MADRAS, work on the introduction of improved types of Cambodia, Karunganni, Northerns and Westerns cottons was continued.

Seed of an improved type of Karunganni cotton was distributed and an area of 72,000 acres sown with it during the year. The area under Nandyal 14 (a selected Northerns cotton worth about Rs. 50 per bale more than the ordinary Northerns) has risen from 8,500 to 20,500 acres, and that under the selected Westerns type, Hagari 25, from 13,000 to 81,000 acres.

The area under irrigated Cambodia rose to 204,100 acres, the yield being estimated at 119,000 bales. The improved strain 295 of Cambodia cotton is being steadily pushed in the Coimbatore District through the aid of private seed farms. Experimental work on Cambodia cotton is progressing, several more promising strains having been isolated. An important investigation on the *herbaceum* constituent of Northerns cotton has been undertaken with the aid of a grant given by the Indian Central Cotton Committee, and selection work on Northerns and Westerns cottons was continued. Promising crosses bet-

ween *G. indicum* and *G. roseum*, and *G. indicum* and *G. cernuum*, respectively, are being studied. The cross between Sea Island and Cambodia is reported to have proved disappointing, but such a variety of types has arisen from this cross that observations are being continued, as something valuable may yet be obtained from it. The results of bud and boll shedding obtained up to date form the matter of a Bulletin by Mr. G. R. Hilson. Unfortunately this work has had to be abandoned for lack of staff.

Further progress has been made with the organization of seed farms for the production of cotton seed of improved strains. Under the old system the department gave seed free to selected growers, guaranteed to purchase their *kapas* at a fixed premium, and also gave advances for cultivation; thus the department incurred considerable risk although in actual fact no loss has been suffered. Under the new system which has been tried experimentally in the Coimbatore District, seed farmers were persuaded to gin their *kapas* co-operatively, the department organizing the ginning arrangements and purchasing the seed only. The ginned cotton remained the property of the ryots and was sold by auction with the help of the department. The advantages of this system are that the department can handle a much larger quantity of seed at the same expense and with less risk, while the ryot is brought to realize directly the enhanced prices obtained for improved cotton.

One of the most serious difficulties with which the Madras Agricultural Department is faced at present in work for the improvement of cotton growing, particularly of Cambodia, is the agitation for an extension of the time permitted under the Madras Pest Act for the removal of old cotton plants. In 1923 this date was again extended to September 1st (which means in practice about September 20th), thus largely nullifying the value of the Pest Act since the two months' minimum dead period between the two crops is not obtained. The lengthening of the cropping season which has been permitted in the last two years is stated to have had a bad effect on the 1923 and 1924 crops. Insect pests are again on the increase, and the marked

improvement noticeable between 1919 and 1922 in the quality of the cotton coming to the markets is now disappearing.

The total area under cotton in the PUNJAB, excluding Indian States, was estimated in 1924 at 1,781,353 acres which is 37 per cent. in excess of the area of the 1923 crop. Of the above area, 675,800 acres are under Punjab-American cotton as compared with 383,851 acres in the previous year, an increase of over 57 per cent. in area under Punjab-American which now forms practically 40 per cent. of the total irrigated cotton crop. The bulk of the Punjab-American is still of the variety known as 4F. The newer variety 285F. reached 21,000 acres in 1923 and is extending rapidly, more particularly in the Lower Bari Doab Canal Colony. Attention is also being paid to the improvement of *desi* cotton for the unirrigated tracts, and the Bhatla variety grown in Hansi is reported to have reached 40,200 acres as compared with 22,000 acres in the previous year.

The Director of Agriculture reports that in 1923-24 farmers realized an additional Rs. 42 per acre by growing American cotton instead of *desi*, and that the additional profit to the farmers of the province aggregated 2½ crores of rupees.

The principal difficulty with which the Punjab is at present faced in regard to Punjab-American cotton is the mixing which takes place in the ginning and pressing factories—a malpractice which is destroying the reputation of the cotton and seriously threatening the growers' profits. The price of Punjab-American cotton at the beginning of the year 1924 was very high and the demand from all consumers keen. As a result of mixed cotton being sold, the price of this cotton relative to other cottons fell later by some Rs. 60 per khandy, or Rs. 30 per bale which is equivalent to Rs. 2 per maund of *kapas*. This experience is likely to be seriously reflected in the prices obtainable for the 1924 crop, especially as the larger American crop has made the demand for Indian stapled cotton less insistent. It is particularly disheartening to the Agricultural Department to find the premiums for American cotton lowered by malpractices of this nature when satisfactory premiums had

at last been established after many years of patient work on the organization of marketing. It is hoped that the Bill for the Regulation of Gins and Presses will enable this abuse to be satisfactorily dealt with.

The department continued the distribution of the Mollisoni type of selected *desi* cotton in the canal colonies, since experience shows that, largely because of the fact that American cotton requires canal water later than *desi* cotton and partly also because it is less suitable to the lightest soils under canal colony conditions, a considerable portion of the irrigated cotton area is likely to remain under *desi* cottons for some years to come. The Mollisoni variety is a better yielder than the ordinary *desi* and the *kapas* fetches a premium of Re. 1 to Rs. 2 per maund (as compared with a premium of Rs. 5 to Rs. 8 per maund for American).

Further work on the study of the more suitable types of acclimatized American cotton for the canal colonies and on the water requirements of cottons under these conditions, is urgently required. It is hoped that this will be provided for shortly, with the assistance of the Central Cotton Committee's research grants which will provide for a special Cotton Research Botanist and staff.

United Provinces. An improved type of Aligarh white flower cotton, known as Aligarh 19 evolved on the Aligarh Experiment Station, has now been introduced on 2,500 acres of controlled cultivation, and 30,000 acres are expected in 1925. This cotton is reported by local mills to be suitable for 12s—13s counts which represents a distinct improvement in staple as compared with the cotton which it will replace. The Director reports that progress is being made in the improvement of yield, ginning and lint characters of the local cottons, but that no great change in the type of cotton produced in the United Provinces, such as has resulted from the introduction of Punjab-American cotton in the Punjab, may be expected. No extension has taken place in the cultivation of Cawnpore-American cotton, and it appears that the impossibility of finding suffi-

cient irrigation will probably prevent any further extension of the area under this type.

Important work is being done on the pink bollworm, part of the cost being provided by the Indian Central Cotton Committee. This serious pest of cotton is prevalent throughout Northern India but more particularly in the United Provinces where it is probably the greatest cause of loss of crop in average years. The experiments are directed to ascertaining what methods of control are necessary, and in particular whether seed treatment, or the destruction of old plants and possibly of alternate foodplants for the pest, is the more important.

In the CENTRAL PROVINCES, the distribution of seed of Roseum cotton is being continued on previous lines. With the assistance of a grant from the Indian Central Cotton Committee, a special Cotton Botanist and staff have been appointed, and a thorough botanical examination of the cottons of the province undertaken, the principal objects in view being the improvement of the staple and the development of types resistant to wilt.

BURMA. Work on the isolation of superior strains of Burmese cottons is being continued at the Mahlaing farm. The best strain of Shan cotton has a staple of 0·88 inch, while the best strain of Wagale has a lint length of $\frac{3}{4}$ inch and a ginning percentage of 37 to 41. Both of these types yield well, and the multiplication of seed stocks and large scale testing is now being undertaken with a view to obtaining also commercial valuations and spinning tests. A number of hybrid cottons are also under study.

The Director reports that the survey of the BENGAL cottons is now practically complete, and it is hoped to start work on the improvement of the hill cottons of the Chittagong and Garo Hill tracts. This will necessitate the starting of a small experiment station in the hill tracts themselves, as these cottons do not thrive in the plains. It is also considered that there are prospects of cottons of the American type doing well in this area; the preliminary results obtained are encouraging.

The Director reports that there is little chance of cotton cultivation ever becoming important in the plains of Eastern Bengal, but that in Western Bengal, and more especially in the uplands of Burdwan, Birbhum, Bankura and Midnapur tract, there are possibilities of success, as there is a need for a revenue crop in this tract.

The area under cotton in the MYSORE State in 1923-24 amounted to 84,000 acres, of which three-quarters is of the Sannahatti or Kumpta type, the remainder being principally Doddahatti or Dharwar-American. The former is grown on the black soils, the latter on the red soils. Work is in progress on the isolation and distribution of improved types of both of these cottons, and despite the set-back caused by the failure of the rains sufficient pure seed has been obtained of Sannahatti 69 to sow about 2,000 acres. The Director reports that as a result of hybridization considerably improved types of Upland cotton have been obtained which, in addition to possessing better staple than the ordinary Doddahatti, are practically free from red leaf blight which at present causes serious loss.

The HYDERABAD State Department of Agriculture has continued its important and successful operations in re-establishing and maintaining the valuable Gaorani cotton (*G. indicum* or Bani), and during the year supplied seed for over 400,000 acres. The total area under Gaorani cotton this year rose to 1,397,000 acres. This type of cotton is in keen demand for Indian mills.

The BARODA Department of Agriculture has continued to co-operate with the Bombay department, particularly as the best cotton-growing areas are much interlaced. Arrangements have been made by which the Baroda department distributes the same type as the Bombay department. The actual issue of improved seed of Surat 1027 A.L.F. was 160,000 lb., but in addition considerable quantities of seed were supplied by the Bombay department's seed depôts. The Baroda Durbar has also, as mentioned above, passed a Cotton Transport Law on the lines of the Indian Cotton Transport Act and notified zones corresponding with those notified by the Bombay Government.

IV. Sugarcane.

According to the final general memorandum on the sugarcane crop for the season 1923-24 issued by the Director of Statistics, the area under sugarcane and the yield of the crop increased from 2,740,000 acres and 3,044,000 tons of *gur*, *i.e.*, raw sugar, in 1922-23, to 2,916,000 acres and 3,266,000 tons of *gur* respectively in the year under report. This is equivalent to an increase of over 6 per cent. in area and over 7 per cent. in yield as compared with last year. The crop suffered in its early stages from drought in many places; but the monsoon rains proved very favourable except in the province of Bihar and Orissa.

The refined sugar manufactured in India by modern factories and refineries amounted to 74,050 tons as against 75,428 tons during the preceding season. The reduction was largely due to the supply of cane being short in Bihar where most of the sugar factories are situated. As India's consumption of refined sugar is greater than her production, no less than 411,500 tons of foreign refined sugar had to be imported during the year under report. It came mainly from Java and Continental Europe.

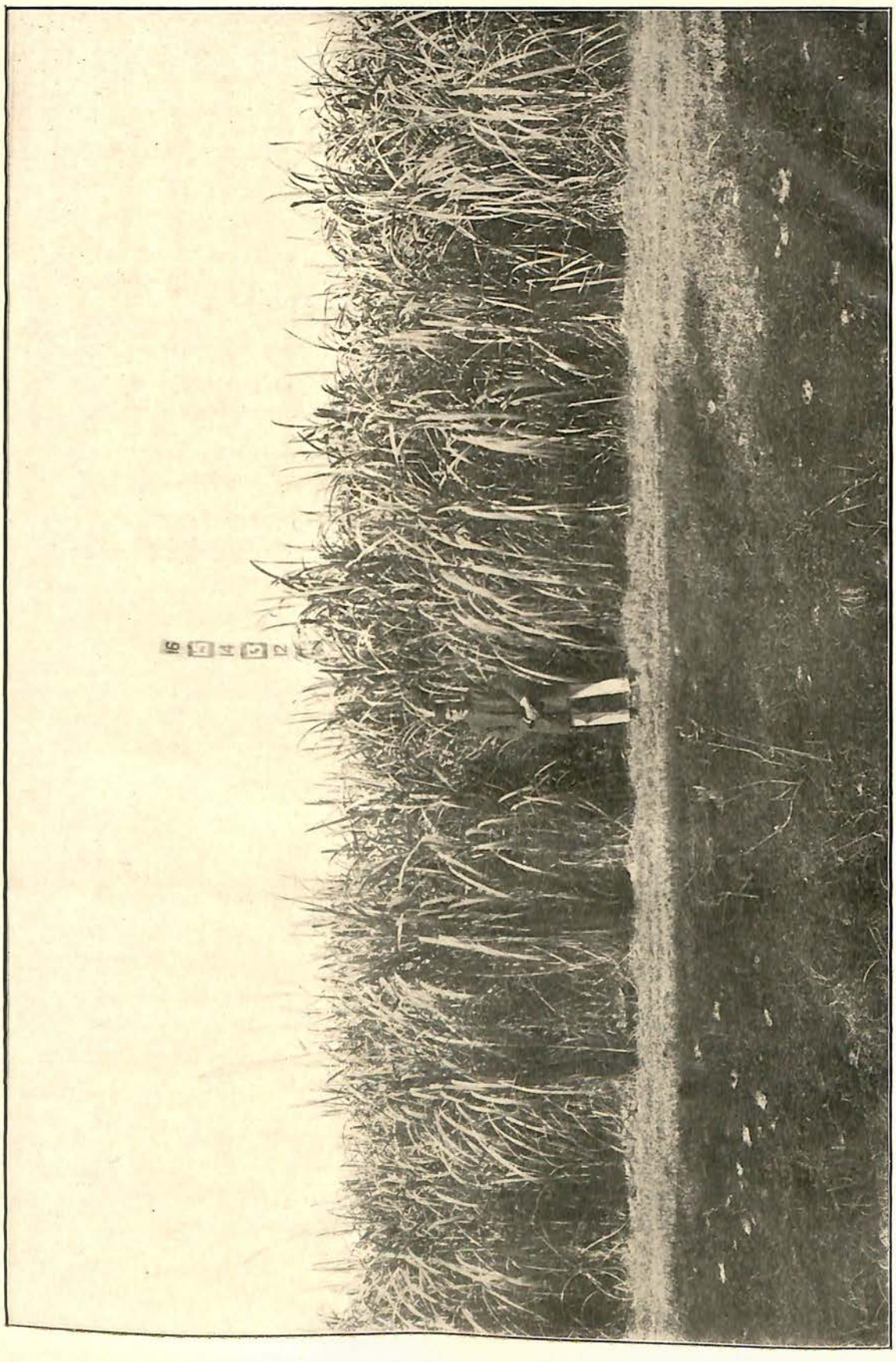
Sugar, unlike other commodities, enjoyed a fairly high level of prices not only in India but in almost all the important markets of the world, with the result that the importation of this commodity into India remained at a low level. The prices of *gur*, on the other hand, were low.

On the agricultural side, the work at the Coimbatore Cane-breeding Station continued unabated and a number of seedlings suitable for different tracts were evolved. Many of the seedlings distributed in previous years have proved their superiority over local canes grown in the various provinces and some of them have readily been taken up by the cultivators. Co. 213 which was tried not only in North Bihar but in the United Provinces, the North-West Frontier Province and Assam, *i.e.*, under very divergent conditions of soil and climate, appears to have done very well everywhere. Co. 210 and Co. 214 have also done well in Bihar, and a large demand

ROYAL ASIATIC SOCIETY. LIBRARY OF THE BOMBAY BRANCH OF THE

PLATE I.

COIMBATORE CANE 213 ON HEAVY LAND AT PUSA IN 1923 (RAINFALL 24 INCHES).



Co. 210 RATOON CANE CROP AT PUSA, 1924-25.

for seed has sprung up. The demand is being met as far as possible from Pusa. In North Bihar where cane has to be grown on natural rainfall only, it is difficult to get the local Hemja or Bhurli variety to survive the hot weather successfully; if the monsoon breaks late the crop goes out as happened this year. The new Co. (Coimbatore) seedlings have a very good root development and therefore go through this trying period with much less difficulty. It should, however, be noted that to get the best out of these canes, they should not be planted close together but in rows sufficiently wide apart to allow of inter-culture with horse hoes in the hot weather, and they should be ridged up at the break of the rains. The result of planting these canes close together, as the ryot does in the case of local canes, is to get a dense crop of a thin spindly cane which, when not ridged up, lodges badly when exposed to wind or heavy rain.

Experiments in ratooning sugarcane at Pusa have so far shown that Co. 210 is a very good ratooner. The same has been the result at Sepaya. The Deputy Director of Agriculture at Sepaya writes that, even with careful inter-cultivation during the dry weather and the application of 246 lb. sulphate of ammonia per acre after the break of the monsoon, Hemja on an average of eight plots gave only 8 tons of stripped cane per acre: Co. 210 in an adjacent area and with exactly identical treatment gave 20½ tons of stripped cane per acre. Mill trials of two more varieties, *viz.*, Co. 232 and 233 which appear to be promising were conducted by the Secretary, Sugar Bureau, during the year under report.

In the UNITED PROVINCES, the selection of better and heavier yielding varieties of canes has now reached a definite stage, and the province is well supplied with a wide range of canes suitable for almost all classes of cultivation. During the present season the crop under Shahjahanpur varieties is valued at 20 lakhs of rupees. The two seedlings Co. 213 and Co. 205 have been found suitable for the Western Circle, and it is anticipated that a considerable area will be under these varieties next year. Co. 205, a thin cane, has given better yields than the local variety known as Chin. The problems which now

require attention are connected with the cheapening of the cost of production under intensive methods of cultivation. These problems are now to be investigated on the Shahjahanpur farm.

Till now Tanna was found to be the most suitable cane for BENGAL, not only for its heavy yielding capacity but also for its drought and disease resisting qualities. The cultivators have taken to it, and an area of some 20,000 acres is under this variety in the Kishoreganj Sub-division, while further large areas are reported to be under it in the Hooghly and Rajshahi Districts. In the varietal experiments conducted during the year Co. 213 gave greater yields than Tanna. It yields a purer juice, too, and is an excellent drought resister. It possesses all the advantages which Tanna has with better tonnage, and it is anticipated that if these characteristics persist, Co. 213 will be extensively grown in the province.

Further work on the manuring of sugarcane has shown that heavy liming in laterite soils is conducive to purity of juice, and that under these conditions potash is immobilized. It is interesting to note that previous results, obtained by Taylor in Bihar, indicated that potash manuring tends to prevent the satisfactory crystallization of sugar.

The special feature of the cane work in North BIHAR has already been referred to. Seed-cane amounting to over 366 tons was distributed by the local Department of Agriculture in collaboration with the Secretary, Sugar Bureau, during the last planting season in North Bihar. The new Coimbatore canes have decidedly proved their superiority over local varieties and have put an entirely different complexion on the problem of sugar manufacture in Bihar. Co. 213 is also being tried on the Sabour farm and other farms on the Bhagalpur side with equally good results: at the Ranchi farm yields of 8,200 lb. of *gur* per acre were obtained from this variety.

From the varietal tests carried out at the Gurdaspur and other farms in the PUNJAB it has been definitely proved that the seedling cane Co. 205 gives a better yield than the local varieties. It has a good root system and stands drought well, and being very hard when ripe is not damaged to any extent by

wild animals. The main objections to this variety are that it ripens late, is hard to crush and is not suitable for fodder purposes. Co. 223 has also done very well on the Gurdaspur farm; while on the Lyallpur farm Co. 205 has given 820 lb. more *gur* per acre than the next best variety—Saretha. Work on the improvement of furnaces was continued; types have been evolved by the department which economize both time and fuel. Successful demonstrations were carried out and 39 improved furnaces were constructed for the zemindars.

The area under cane in the BOMBAY PRESIDENCY decreased during this season as a result of the fall in the price of *gur*. The varietal tests carried out during the last four years at Manjri have shown that Red Sport and D. 109 give from 40 to 50 per cent. more *gur* per acre than Pundia, the standard local cane, while Manjav gave the best results in the (Godavari) canal tract. The manurial experiments at Manjri show that the application of top-dressings of ammonium sulphate and safflower or castor cake applied in three doses and supplying up to 300 lb. of nitrogen, when applied in addition to the ordinary heavy dressing of farmyard manure containing 200 lb. of nitrogen, gives a progressive increase in the yield of cane. Other experiments carried out on this farm show that proportionately heavy yields can be obtained when cane is irrigated to the extent of 125 acre-inches. Hitherto it was generally considered that 75 acre-inches (*plus* rainfall which at Manjri is about 22 inches) were adequate to produce a full crop.

In the MADRAS PRESIDENCY, an attempt to raise seedlings at Anakapalli met with a fair measure of success. The work at the Sugarcane Breeding Station at Coimbatore remained in charge of Rao Sahib T. S. Venkatraman. In the year under report a very large number of the varieties and seedlings arrowed and gave an exceptional opportunity of producing new combinations by cross-breeding. No less than 170 different combinations were attempted and about 130,000 seedlings were raised. A special study has been made of the root system of canes and of the effect of the treatment of sets with insecticides and fungicides.

The study of the red rot disease of canes on the Samalkota Experiment Station indicates that methods of cultivation as well as the use of infected seed have an influence on the prevalence of this disease. Frequent cultivation of the soil when it is in a dry state seems to be conducive to the disease. In the varietal tests on this station, J. 247 established its superiority both as regards yield and drought and disease resistance. Of the new varieties introduced from Coimbatore, A.2 appeared to be the most promising.

A.2a ratooned best at Jorhat in ASSAM and, if protected from jackals, should form a very useful cane for cultivators. J. 33a, a heavy yielder with a medium quality of juice, also proved a good ratooner; but it is a very hard cane. Of planted canes, J. 1547 showed up best, followed by D. 74 and J. 33a. J. 1547 is not only a heavy yielder but also gives the highest amount of sucrose per acre. D. 74 follows closely and is a good cane from the cultivators' point of view; it stands erect and ratoons well.

Hmawbi, Tatkon and Hopin are the three stations working on cane in BURMA. At Hmawbi, J. 213, Striped Mauritius, P. Mauritius, Fiji and B. 3412 gave the highest outturns of *jaggery* per acre. At Tatkon the exotic varieties J. 213, B. 3412, J. 247 and B. 376 were found superior to local varieties. On this station, cane planted in rows four feet apart gave the best yields. The results obtained at Hopin have induced a Rangoon firm to take up 6,000 acres of land and to establish a white sugar factory at Sahmaw—the first venture of this kind in Burma.

In the NORTH-WEST FRONTIER PROVINCE, the superiority of the Assam Red variety over the local Poundia is now well established and it is anticipated that the former will be extensively grown in the province. The seedling cane Co. 213 has been tried with almost equal success. The results of the interesting trials made in clamping green tops and cane stools, with a view to utilizing them for seed, instead of using whole canes, have so far been encouraging, and are expected to bring

about a great saving in the cost of cultivation. Sugar-beet continued to be tried and did very well.

In MYSORE, the work on cane has been conducted on a variety of lines. On the Babbur farm, J. 33a proved itself distinctly superior to the local Rastali cane and it was closely followed by H. M. 544 and H. M. 553. The area under the varieties introduced by the Agricultural Department is now about 3,000 acres in the western part of the State alone. Oil-cake and ammonium sulphate are being widely used as manures for cane in areas where previously these manures were unknown—an eloquent tribute to the demonstration work of the department.

Owing to floods, no results could be obtained from the varietal tests carried out on Alwaye farm in the TRAVANCORE STATE, but irrigated cane grown on poor laterite soil on the Trivandrum farm gave satisfactory results. Cultural and manurial demonstrations were conducted on ryots' lands, and manure and sets for the purpose were supplied free of cost by the Agricultural Department of the State.

V. Jute.

The world's supply of jute fibre is drawn almost entirely from North-east India and the monopoly is worth retaining. The area under the crop is necessarily regulated mainly by the demand from abroad and the price the raw material fetches in the market. The trade depression brought about by post-war conditions affected the area under this crop to such an extent that it shrank to 60 per cent. of the average area sown in the quinquennium immediately preceding the Great War. Such a heavy reduction in output naturally forced up the price which induced the growers to put more area under jute, with the result that the estimated acreage of 2,691,000 in 1923-24 showed an improvement of 17 per cent. over the preliminary figures for the previous year. The estimated yield rose from 5,408,000 bales of 400 lb. each to 6,940,000 bales, the outturn per acre being better by 49 lb. than in 1922-23. The value of raw and

manufactured jute exported during the year was, however, only Rs. 62,28 lakhs as against Rs. 63,02 lakhs in the preceding year.

Two main species of jute, *viz.*, *Corchorus capsularis* and *C. olitorius* are cultivated in India, but it is from the former that the bulk of the crop is derived. One of the most successful pieces of work of the BENGAL Agricultural Department is the isolation of superior yielding strains of both these species. Among the non-chlorotic *capsularis* races isolated from Kakya Bombai, D. 154 has proved to be the highest yielder and is followed closely by R. 85. The departmental selections are so much in favour in certain parts of Eastern Bengal that it is estimated that at least half of the fibre imported into Narayanganj is the product of the seed originating from them. The reputation of *olitorius* Chinsura Green for heavy yielding powers has spread from Eastern to Western Bengal and has led to extensive sales of its seed during the year. Varietal tests with some of the hybrids were carried out, but owing to unsuitable weather the results were vitiated. Nevertheless, one of the hybrids, D. 39, promises well as regards yield, but its stem is unfortunately red in colour.

An investigation into the correctness or otherwise of an old standing conviction in the jute trade that the environment, and not the seed, is the determining factor in the quality of the fibre is in progress. This investigation is being carried out at different centres under different soil and climatic conditions in collaboration with the Indian Jute Mills Association and the Dundee Chamber of Commerce. The results are not yet conclusive, but in some cases they seem to challenge the opinion held. The first year's results have incidentally confirmed the reputation of the Dacca selections as producers of good quality fibre.

Manurial trials made at Pusa and Dacca point to the efficacy of sodium sulphate towards diminishing the incidence of disease in jute.

A number of retting experiments conducted with different varieties of jute tend to prove that the quality of the fibre

depends not so much on the variety as on the method of retting. Water hyacinth commonly used by the cultivators to weigh down the jute stems was found to hasten the retting action.

The establishment of a farm at Purnea this year will enable the BIHAR department to test the suitability of the different Dacca selections for the jute-growing tracts of the province. The area under Kakya Bombai has expanded considerably in this province during the year under review.

With an increase in the number of East Bengal immigrants, jute is rapidly becoming an important crop in the Goalpara, Kamrup, Nowgong and Sylhet Districts of ASSAM and a strong demand has grown up for Government seed. Dacca R. 85, when tested against the local seed in different parts of the province, gave an increase in yield ranging from 150 to 500 lb. per acre.

In the Ganjar tract of the UNITED PROVINCES, where conditions are similar to those existing over large areas in Bengal, the growing of jute has proved to be much more profitable than any other crop. Though the fibre produced is of poor quality, the local markets can absorb the produce of at least 10,000 acres for rope-making.

VI. Other fibres.

Sann-hemp. Further progress has been made at Pusa towards evolving a process of artificial extraction of sann-hemp fibre. In the United Provinces, the Punjab and the Central Provinces, sann is grown on a very large scale for its fibre and because it is recognized as a soil renovator. The absence of suitable facilities for retting the fibre prevents any great extension of the cultivation of the crop. With the machine designed for artificial extraction the cost works out at Rs. 97-8-0 which leaves a very small margin of profit; but on account of its better quality, it should fetch an appreciably higher price in the market than ordinarily prepared hemp does. It also seems possible to reduce the cost by adding labour-saving fittings to the machine.

Rhea. Owing to the absence of demand for a number of years, the area under rhea—in some respects one of the finest fibres available in India—has diminished in Bengal almost to the vanishing point; but the high prices prevailing for cotton have helped to stimulate fresh interest in this fine fibre which, owing to the high cost of production, has never found its place in the world's market. Should cotton continue to maintain a high level of prices, rhea may become a commercial possibility.

Sida. The work on the selection of non-branching Sida races is being continued at Dacca. It is a very much finer fibre than jute and could, it is believed, be used for the latter in the manufacture of fibre fabrics.

Agave. The races of sisal hemp which pole early have been separated at Dacca from those which pole late. Some of the former flower and die after 4 years, while many of the latter do not flower for 12 years or more. The expensive and non-productive periods of planting and the immaturity of the strains which flower late have been reduced to a minimum. These strains are correspondingly more efficient fibre-producers than the others.

VII. Tobacco.

The most important tobacco tracts in British India are to be found in the provinces of Madras, Bengal, Bihar, Burma and Bombay, where on an average a million acres are occupied by this crop. The resultant produce is a coarse leaf which to some extent meets the local taste, but fails to give the finer grades of tobacco, the demand for which is indicated by the fact that India imported during the year under review tobacco of the value of Rs. 2,26 lakhs as against the pre-war average of Rs. 71 lakhs. Her export of tobacco for the year amounted to Rs. 1,02 lakhs. The Agricultural Department aims at increasing the outturn of better quality Indian cigars through selection of leaf, and at decreasing the imports of foreign cigarettes by producing tobacco suitable for their manufacture in India. The problems connected with curing, fermentation, etc., have also to be solved for the realization of the aim and are engaging the attention of the department.

The breeding work at PUSA is being carried on and there are now 51 types of *N. Tabacum* and 20 types of *N. rustica* in pure cultures. The research into the inheritance of characters in the latter, and also into the phenomena of parthenogenesis and parthenocarpy in the former, has reached a stage when it has been possible to publish the results hitherto obtained. No evidence has been obtained that parthenogenesis develops with acclimatization, but it has been found that large and vigorous plants give a high percentage of parthenocarpic fruits, whereas poorly grown plants of the same variety give none at all.

The Pusa selection 28, a tobacco of light colour and good texture and altogether suitable for cigarette-making, continues to gain favour among cultivators in Bihar, Madras and Burma. The seed distributed from Pusa for sowing 8,000 acres met only a fraction of the demand.

The investigation into the different methods of tobacco-curing has shown that rack-curing is more effective than ground-curing in reducing the volatile nicotine which gives an undesirable sharpness and pungency to the smoke from certain types of tobacco.

The BENGAL department maintains a special farm at Burirhat where the problem of tobacco improvement is being attacked from various sides. The reputation of the Sumatra leaf grown on the farm as a cigar wrapper has now been well established. Efforts are made to find out a better filler than Sumatra in order to establish cigar-making as a successful enterprise. Of the varieties tested during the year for the purpose, Pennsylvania Board seems to be the best, with Manilla No. 2 a close second. Among the indigenous varieties, Bhengi has proved to be the heaviest yielder and fetches the highest price from the Burmese dealers who make the well-known Burma cheroots out of this variety. Ohio, White Burley, Mauritius and Orinoco are the exotic varieties under trial for their suitability for cigarette-making. Further manurial trials have confirmed the efficacy of fish manure and groundnut cake as most suitable fertilizers for tobacco. This year's experience in flue curing indicates the

necessity for further improvement in the structure of the curing shed to secure a better regulation of temperature and moisture.

Experiments are being started at the newly opened farm at Purnea in BIHAR to evolve a hybrid by crossing a pure *desi* tobacco like Pusa 28 with an American type such as White Burley, which may be more suitable for export than the heavy, dark type of leaf ordinarily cultivated. A trial crop of Pusa 28 at Sepaya indicates that tobacco could be grown successfully in the Saran District, though the popular belief is otherwise. The yield worked out at 11 cwt. per acre of first and second class leaf and would have been better had the crop not been damaged by hail in March. The quality was reported to be satisfactory by the cigarette factory which purchased the crop.

The Rangpur selection—Matihari—is getting quite popular in the Surma Valley of ASSAM; the improvement of the local varieties by seed selection is being attempted.

The most important tobacco problem in BURMA is the curing of the leaf, and it is hoped that the scheme which is being prepared for systematic work on this crop will include the appointment of an experienced curer.

VIII. Oil-seeds.

The area under the principal varieties of oil-seeds—linseed, rape, mustard, sesamum and groundnut—rose from 17,266,000 acres in 1922-23 to 17,613,000 acres in 1923-24; but owing to unfavourable weather conditions the total yield declined from 3,459,000 tons to 3,125,000 tons. The yield per acre of linseed fell by 76 lb., of rape and mustard by 46 lb., of sesamum by 24 lb. and of groundnut by 168 lb. The total quantity of oil-seeds (including castor and cotton seeds) exported during the year was 1,255,000 tons (valued at Rs. 29,81 lakhs) as against 1,177,000 tons (valued at Rs. 27,35 lakhs) in the preceding year, and that of oil-cakes 178,000 tons as against 151,000 tons in the preceding year.

While the area and yield show very little variation from the average of the five years ending 1914-15, the exports are

below the pre-war average by 200,000 tons. The natural conclusion is that more oil-seeds are crushed locally than before and that larger amounts of oil-cakes are now used in the country for cattle food and manure.

Linseed. A detailed investigation at PUSA into the biology, taxonomy and economic aspects of the Indian linseed crop has resulted in the isolation of different types, of which at least three give better yields than the mixtures at present grown on the alluvium. About 8 cwt. of seed of types 12 and 121 were given out this year for trial; in every case both types gave heavier outturns than the local mixed crop. A systematic study of this crop has also been started in the UNITED PROVINCES.

Castor. Thirty-three varieties of castor have been collected in the UNITED PROVINCES with the view of isolating pure strains and of studying their oil content in collaboration with the Oil Expert of the Department of Industries.

Sesamum. In BURMA, 22 early and 36 late varieties of sesamum are being tried with a view to selecting a higher yielding substitute for the previously selected Pyigyi. An investigation is also being made into the causes of the condition known as " green flower " which often seriously damages the sesamum crop.

Groundnut. In BURMA, Spanish groundnut has proved definitely superior to Burmese varieties in oil content; it also matures earlier.

As a result of the introduction of Spanish groundnut, the area under this crop in one district of BOMBAY has risen from 4,100 to 106,044 acres in a decade. This variety matures early and can be grown without irrigation.

The selection work at Ranchi in BIHAR AND ORISSA has yielded a type called Kanke 17 which, during the year under review, did well at Kanke, Purulia, Sambalpur and Ramgarh although the season was distinctly unfavourable for this crop. The cultivation of groundnut is spreading in the Patna and Bhagalpur Circles.

The introduction of erect types of groundnut has given a great impetus to the cultivation of this crop in MYSORE, but

although they mature early and are easy to harvest, the yield is low. An attempt is therefore being made to combine, by hybridization, the desirable habits of the erect types with those of trailing ones.

Coconuts. The belief current in the MADRAS PRESIDENCY that it is necessary to water coconut seedlings in the hot weather during the first few years of their growth appears to be based on insufficient data. Experimental work at Kasargod has convincingly demonstrated the possibility of raising coconuts without any watering whatsoever, provided deep ploughing is done in the first instance and the top layer of soil frequently stirred during the hot weather to conserve soil moisture. Coconuts raised on demonstration plots under this dry system of cultivation stood the test thoroughly. There was a phenomenal demand for seed-nuts and seedlings to plant up areas which had hitherto been treated as unculturable waste.

A collection of different varieties of coconuts from all over the world is being made at the coconut stations of the department. An interesting investigation into the self-pollination of a few heavy yielding trees of a desirable type has been undertaken, with a view to ascertaining whether the heavy yielding capacity is an inherent character of these trees, or is merely accidental.

Trials made on a small scale at Kasargod show that a good crystalline sugar of fair purity can be obtained from the juice of the coconut palm, and that sugar-making is more profitable than either selling the juice as *toddy*, or leaving the tree to bear fruits.

Work on coconuts at Cuttack in ORISSA is confined to the selection of suitable, early and heavy yielding varieties. The testing of suitable cover crops likely to provide nitrogen and humus and give some return on the capital invested is also receiving consideration.

At the newly established coconut station at Akyab in BURMA, different manures and methods of cultivation are being tried.

In TRAVANCORE, manurial and spacing experiments were continued and a large number of disease-resistant coconut seedlings sold.

The Pest Act for the control of the coconut caterpillar (*Nephantis serinopa*) was in force in Madras during the year.

IX. Tea.

The area under tea, 83 per cent. of which lies in Assam and in the two contiguous districts (Darjeeling and Jalpaiguri) of Northern Bengal, showed a slight rise from 708,199 acres of the preceding year to 710,289 acres in the year under review. While the acreage thus showed an expansion of only one per cent., the total estimated yield of 375,355,689 lb. represented an increase of 20 per cent. over the figures of the previous year. The average production in the whole of India was 561 lb. per acre plucked, as against 477 lb. in 1922. The phenomenal prices fetched by tea induced the producers to employ more labour at high wages, and this, combined with the unusually favourable weather prevailing throughout the year, helped to increase the production. It is, however, not equal to the world's demand, and the prices obtained are the highest ever known since the beginning of the industry in North-east India.

The scientific staff of the Indian Tea Association has been investigating not only problems relating to the improvement in yield through soil treatment, and to control of diseases and pests, but also those connected with the quality of tea under varying conditions of fermentation. A new experiment has been initiated during the year to determine the most profitable quantity of nitrogen to apply annually to tea.

In Southern India, the crop is dealt with by the agricultural staff for the planting districts. This staff is paying special attention to the diseases of tea, and to the control of mosquito blight in particular. This blight is apparently closely linked up with the chemical composition of the soil and the ratio of available potash to available phosphoric acid. Potassium nitrate at the rate of 2-3 oz. per bush has proved effective in

overcoming an attack of brown blight. The beginning of hot dry weather is indicated to be the best time for pruning tea bushes.

X. Coffee.

The Indian coffee industry is practically confined to a tract in Southern India, comprising part of the Madras Presidency, Coorg, and the States of Mysore, Travancore and Cochin. The total area reported under the crop was 129,845 acres—an increase of 1,415 acres or 1 per cent. over that of the preceding year. The production of cured coffee fell from 25,380,348 lb. to 22,716,452 lb., but the exports amounting to 218,000 cwt. showed an increase of 49,100 cwt.

Comparative trials were carried out at the coffee station in MADRAS with Jackson's hybrid and Kent's selection; the latter is the more promising. It has not only vigour and high-yielding capacity but also a certain amount of disease-resisting power. Another promising hybrid is the Liberian arabica.

The value of spraying with Bordeaux mixture against leaf disease and " die back " was demonstrated during the year; the yield of coffee obtained from the sprayed plots was more than treble that of the unsprayed plots.

The MYSORE department has found a number of alternate hosts for the fungus which causes the " black rot " of coffee, and is engaged in devising measures for combating it successfully.

XI. Rubber.

Rubber is grown mainly in Southern India and Burma; in the year under review the area amounted to 128,787 acres, which is 2 per cent. above that of the previous year. Of this area, only 74,371 acres were tapped. The total production of raw rubber during the year is reported to have risen to 14,469,428 lb. as against 11,912,950 lb. for last year. The quantity exported to foreign countries showed an increase of 23 per cent.

The problem of budding Hevea rubber under local climatic conditions is being investigated in Southern India. The difficulty of getting suitable bud bark has been overcome by topping the larger branches of the selected mother trees 9-10 months previous to budding, and spraying the shoots to protect them from attack by *Phytophthora*. The patch method of budding adopted in the Dutch East Indies has been found unsuitable, but a method in which an H cut is made in the stock and the bud inserted by raising the two lips, both being afterwards closed and bound down tightly over the bud, has proved highly satisfactory.

All attempts to control by soil treatment the ravages of *Phytophthora Meadii*, which produces abnormal leaf-fall, have failed, but spraying with Bordeaux mixture has proved a cheap and effective remedy. It has been ascertained that stripe canker can be prevented by the application of antiseptics to the tapping cut. It will no longer be necessary, therefore, to suffer loss of yield by adopting a system of shallow tapping during the monsoon. The Keuchenius isolation method for treatment of brown blast having proved satisfactory, classes were held during the year to teach estate writers how to apply it.

The problems connected with the black thread and abnormal leaf-fall of Para rubber are under investigation in Burma.

XII. Fruit.

In the absence of trained specialists in fruit growing, fruit culture has not received as much attention as its importance demands, but the results of work done at Tarnab, Quetta and other places have opened up a vista of great possibilities of improving the value of orchards by giving attention to the selection of trees and to the proper tillage of the soil. For a thorough investigation of the economics of fruit growing in different parts of the country, the creation of a special horticultural section in all Provincial Departments of Agriculture is essential. It is hoped that the lead given by Bombay will soon be followed in other provinces.

The varieties of peaches and plums selected at Tarnab are now extensively grown in the NORTH-WEST FRONTIER PROVINCE, as they fetch prices three or four times higher than those obtainable for the old Peshawar kinds. Men trained on the farm in improved methods of budding have started nurseries of their own in the neighbourhood, and are doing a good deal of business in Tarnab varieties. While in 1911, when the first fruit nursery was planted at Tarnab, there was hardly one man in the province who could bud 24 trees in a working day, there are many now who can bud 200 to 500 peach, plum, pear or apricot plants in 8 hours' time. It is hoped to lay down this year a commercial orchard of 35 acres at Tarnab to demonstrate that it is possible to realize a net profit of not less than Rs. 500 per acre throughout the entire life of the plantation. Of the several varieties of olive on trial, one kind has given a crop of 70 lb. of perfectly sound plump fruits at the early age of six years from the date of planting. This tree has not been irrigated since it was planted.

The newly appointed Horticulturist in BOMBAY has evolved during the year a method of drying the Poona fig by which a product much superior to the foreign fig is obtained. A study of the different varieties of grape-vines cultivated in the Deccan indicates that the shy-bearing character of some of the superior varieties can be overcome by making adequate provision for cross-fertilization, *i.e.*, by growing plants of low-yielding varieties giving high quality fruits, intermixed with plants of a heavy-yielding type.

The pomological station at Coonoor and the fruit gardens at Kallar and Burliar in MADRAS now carry a full stock of nursery plants of all kinds and there is a steady demand for them from the public. The fruit produced also finds a ready sale; but, on account of the adverse season, the yields were low last year and only 45·3 per cent. of the expenditure was recovered in receipts. The success of certain classes of fruit such as Sapodilla having been demonstrated at Kallar, a new orchard has been laid out for growing similar species at Taliparamba where the conditions are somewhat similar. Varietal tests with plan-

tains at Samalkota indicate that the Mauritius variety is superior in yield to the local Chekkarakeli. The West Indian practice of raising banana plants from eye-buds is being tried at Palur; it is reported to result in more uniformity in the ripening of the crop as well as in bigger bunches.

The 30-acre horticultural garden at Hmawbi in BURMA is being laid down with Nagpur oranges, Malta lemons, Indian mangoes and African oil palm. The Shan variety of oranges is being introduced in the Amherst District with a view to reviving what was once a flourishing industry.

The Salem variety of plantains has done best in the soil of the Babbur farm in MYSORE, other varieties tried being much more sensitive to its marked alkalinity. Spraying operations were successfully carried out in all fruit-growing tracts against various diseases and insect pests infesting the orchard.

XIII. Fodder crops and grasses.

The PUSA system of growing lucerne on flat beds two feet wide, with irrigation furrows one foot wide between the beds, was compared during the year under review with the usual ridge system. Although the season favoured ridges, the total yield of the flat beds exceeded that of ridges by over 10 per cent. The bed system also saved irrigation water by 25 per cent.

Berseem (Egyptian clover) is being grown at Pusa on a large scale every year on irrigated land. It is followed in the same year by a second crop of early maize. The soil is enriched to such an extent by the clover that large crops of maize are thus obtained without manure. Instead of having to cut and cart the clover to the sheds, the cattle are folded in the clover fields where they graze to their heart's delight on this luscious green fodder. By cropping a comparatively small irrigated area with clover followed by maize a large herd of cattle is provided with all the bulky green fodder they require throughout the year. The maize is made into ensilage and fed during the rains

and hot weather. The clover is grown and fed from December till April. The outturn of berseem, as estimated from the harvested plots, amounted to 38,000 lb. per acre for four cuttings.

The introduction of berseem in the NORTH-WEST FRONTIER PROVINCE has achieved so much success that in certain parts of the province it is now more commonly grown than shaftal. As clover sets a fair amount of seed on the Tarnab farm, its production at present prices for sale to other parts of India should prove very profitable in the Peshawar valley. The Kikuyu grass (*Pennisetum clandestinum*) imported from South Africa promises to solve the permanent pasture problem in the province. It stands drought much better than *dhub* (*Cynodon dactylon*) and establishes itself very quickly when planted out in March in small turfs 2½ ft. apart. The sub-tree mesquite (*Prosopis juliflora*), the beans of which are eagerly eaten by sheep and goats and by cattle when they are really hungry, is also under trial at Tarnab. It flourishes vigorously in the sun-baked soils of this part of India and yields an abundant supply of beans of high feeding value, as well as wood which is a valuable fuel.

Feeding trials with fresh *shisham* (*Dalbergia sissoo*) leaves, which form a useful emergency fodder in the PUNJAB, having failed to give satisfactory results, the making of *shisham* silage was resorted to. The experiment was a great success: when fed to milch cows, the silage had no appreciable effect either on the quantity or the quality of the milk.

The renovation of poor pastures is under study in BOMBAY. The storage in years of plenty of *juar kadbi* (dried sorghum stalks), on a large scale and in a portable form, is also receiving attention.

In the UNITED PROVINCES, sunflower when sown after a *kharif* maize crop was ready for cutting after 2½ to 3 months and gave with irrigation 18,000 lb. of green fodder per acre. The possibilities of storing silage in pits for a longer period than a year are being investigated.

A collection of fodder *juars* has been made at Mahlaing in BURMA and the types are being studied for yield and resistance

to the Pwinbyu parasite. Seed of the early type known as Saccoline, imported from New South Wales, is being distributed in the Meiktila and Yamethin Districts.

Guinea-grass and Elephant-grass have done well in ASSAM; clumps of the former are being supplied from the Jorhat farm to cattle owners desirous of trying this new fodder crop.

At Pusa and Sepaya in BIHAR, *math* (*Phaseolus aconitifolius*) has proved the highest yielder of the fodder pulses under trial. *Val* (*Dolichos lablab*) sown at Pusa after maize grown for fodder has been found to give a fair yield both of grain and fodder. The pods are picked when ripe and the plants are cut and fed later, when still green and succulent.

Silo pits filled four years ago with green *juar* on the Imperial Government Farm at Karnal were opened this year. The silage was found to be sweet and good and was relished by the farm cattle. The *kutcha* pits were in this case dug in heavy alluvial soil, and no arrangement of any kind was made for draining away the water.

XIV. Juar (Sorghum).

Juar runs close to wheat in acreage, covering as it does an area of over 31 million acres. Its grain forms the chief article of diet of a large section of the population in Bombay, Madras, the Central Provinces and the Hyderabad State, while the stems are of equal importance in the dietary of the cattle of these parts.

In BOMBAY, improved strains of *juar* have been obtained at Dharwar, Surat and Larkana by selection. The results of two years' experimental work indicate that ridging and intercultivation increase the yield by 23 per cent., while manuring along with ridging raises the outturn by 24 to 31 per cent. in the heavy soils of South Gujarat which are liable to water-logging.

Trials of sorghum at Nandyal in MADRAS have resulted in the preliminary selection of three types, *viz.*, T. 1, T. 6 and T. 12, which will be further tested before being given out for trial in the district. The degree of *Calocoris* resistance in *juar*

is being studied with a view to evolving a strain which will be immune to this pest.

The value of copper sulphate as a preventive for *juar* smut is now fairly well known in *juar*-growing provinces, and it is being used for that purpose on a fairly large scale by cultivators.

XV. Ragi (Eleusine coracana).

The work on the improvement of *ragi*, which is the most important crop in Mysore, was continued on the lines of plant-to-plant selection. In H. 22 the department has got a strain which stands droughty conditions very well and gives a higher yield than local mixtures, but its long period of growth makes it unsuitable for some tracts. What is required is a strain which, while ripening about two weeks earlier, will yield as much or more than H. 22. It is expected that two or three selections distributed this year to selected cultivators will probably fulfil these conditions. *Ragi* plots to which ammonium sulphate was applied on the Hebbal farm yielded 50 per cent. more grain than those manured with cattle dung only, and the additional net profit was Rs. 23 per acre.

Breeding work on *ragi* is being done at Kalimpong in BENGAL. Of the two local kinds commonly grown, the open loose headed variety has been found to yield about 143 lb. per acre more than the curly closed one.

XVI. Potatoes.

Although a relatively recent introduction into this country, the value of the potato as a food crop is now thoroughly appreciated. Any rapid extension of the area under this crop is handicapped by the difficulty experienced in obtaining disease-free seed, but this big problem is being tackled in several provinces.

In ASSAM, the work of acclimatizing, testing and distributing potato seed is being carried out on the Upper Shillong farm; but none of the varieties imported in 1921 have yet been able to beat the older selections, *viz.*, King of Potatoes, Windsor

Castle and Imperator. The demand for selected tubers of the imported varieties is increasing rapidly. To expedite more rapid propagation, seed potatoes are being distributed to Khasi cultivators on condition that they return one and a half times the quantity of the seed supplied; 6·3 tons of seed was issued on this system during the year. Summer seed properly stored has given higher yields than winter seed, the difference being 1,232 lb. per acre during the year under report. Under-ground storage has not been found to give satisfactory results, but the experiment will be continued under more carefully controlled conditions.

A new introduction known as Alnwick Castle gave a yield of $4\frac{3}{4}$ tons of potatoes per acre as a monsoon crop at Naterhat in BIHAR AND ORISSA. Trials at Sabour indicate that with the application of sulphate of ammonia and castor cake 5-6 tons of potatoes per acre can be raised on ordinary lands in Bihar.

In the UNITED PROVINCES, an attempt is being made to ascertain whether cold storage of potatoes is applicable and economical under local conditions. Wool waste, which is available in large quantities at Cawnpore, has been included in the manurial experiments of the department in order to ascertain whether it is a more profitable potato manure than oil-cake meal.

A large demand has grown up in the PUNJAB for Scotch potatoes raised in the Simla hills, which give on an average an income of about Rs. 100 per acre more than the local varieties.

The system of potato cultivation evolved at the Nanjanad potato farm in MADRAS results in a saving of Rs. 13 per acre. Trials made in the Shevaroys during the year indicate that this crop can be introduced successfully in areas outside the Nilgiris.

XVII. Beans and pulses.

The work on the isolation of a prussic acid-free strain of the Burma bean Pebyugale (*Phaseolus lunatus*) has received a set-back through all the best selections having given double the normal amount of acid. This is ascribed to the failure of late

rains, and little doubt now remains but that the formation of the glucoside is increased when the growth of the plant is interrupted for want of moisture. Several varieties of Japanese beans (*Phaseolus vulgaris*) and of the Moki Lima bean from Egypt, which are generally free from prussic acid, are being tried with a view to providing a suitable substitute for the local Pebyugale; but owing to the failure of late rains the year's experiments were, in general, abortive. The collection of different varieties of gram made at Padu in Burma indicates that the Karachi variety, the seed of which has already been extensively distributed, is the only really wilt-resisting type. Crosses are now being made between a white-flowered susceptible variety and an immune pink-flowered one, with the view of evolving an immune type the white flower of which will serve to distinguish it from other kinds in the field.

In Bihar, Sabour type 4 has established its superiority not only over the local grams but also over Pusa 24. The Sabour selections have the additional advantage of having golden-coloured grains, while the Pusa variety has a black grain. Pusa types 17 and 18 are now being extensively grown in the United Provinces.

Twenty-six types of Punjab grams and five fixed crosses are under trial at Lyallpur; Nos. 2, 17, 25, 4, 3, 22, 18 and 20 have proved heavy yielders.

Selection work on *Cajanus indicus* in Burma has yielded types which are likely to meet the demand for an early maturing red-seeded variety.

CHAPTER III.

RESEARCH AND INVESTIGATION.

In addition to the economic work on crops detailed in the previous chapter, a large amount of research and investigational work is being done by the various Departments of Agriculture in India. Most of the investigations referred to below are still in progress and have not yet reached the stage at which the results can be of practical importance. They deal with problems such as the conservation of soil moisture, the movement of nitrates in soils, the reclamation of saline lands, the storage of farmyard manure, the possibilities of producing artificial farmyard manure, the efficiency of different methods of green-manuring, the solubilization of mineral phosphates and animal nutrition. Some of the outstanding results are briefly noticed below; but for detailed information relating to the investigations carried on those interested in any particular branch of research are referred to the Scientific Reports of the Pusa Institute and to those of the provincial research officers which are published separately.

I. Soils.

Survey of soils. Soil surveys are in progress in Madras, the Punjab, Bihar and Burma, which when complete should yield information of great value.

A soil survey of the Malabar District is being made in MADRAS, and the work, so far as it has progressed, tends to show that the soils of this district, like those of others previously surveyed, are deficient in nitrogen and phosphoric acid. A preliminary examination of the soils of the Presidency from the point of fixation of ammonia has shown that they fall into two main groups, *viz.*, the irrigated swamp paddy and black cotton soils which fix ammonia by a process of base exchange; and the lateritic soils of the planting districts which fix the acid radical. The latter phenomenon is ascribed to the presence of large amounts of iron and alumina in the soils.

A systematic survey of the *bara* soils (containing sodium carbonate) has been started in the PUNJAB with a view to ascertaining the expediency of attempting to reclaim such lands.

In BIHAR AND ORISSA, a soil survey of South Bhagalpur and South Monghyr tract in the basin between the Kharagpur hills and the Barabar hills in Gaya indicates that the river systems in the province cutting through particular rocks have brought about characteristic changes in the chemical composition of soils in the region through which they pass.

The "available" phosphate in calcareous soils. In connection with the investigation at PUSA on the method of estimating the amount of available phosphoric acid in calcareous soils, it has been found that the underlying principle of the action of potassium carbonate on calcareous soils is that a reaction takes place with dicalcic and such other acid phosphates as may be present in the soil, and that this leads to the production of insoluble tricalcic phosphates and soluble potassium phosphate. Hence the amount of phosphoric acid found in the extract is an approximate measure of the available phosphate of these calcareous soils. Thus, the potassium carbonate method is capable of measuring the probable fertility of highly calcareous soils in their relation to available phosphoric acid, and appears to be a decided improvement on the existing citric acid method.

Reclamation of saline lands. The experimental work on the reclamation of the saline soils of the Montgomery District in the PUNJAB was continued both in the laboratory and in the field. In *bara* soil thoroughly washed to remove toxic salts plants have been found to flourish to the same extent as in normal soils; but practically no germination occurs in unwashed soil. A scheme based on the principle of washing the soluble salts out of the surface soil ino the sub-soil has been adopted for the Ganji Bar farm. It is proposed to keep the land under water continuously for a period of six months if possible without allowing it to dry. At the end of the period suitable leguminous fodder crops are to be grown and grazed off by farm stock.

Buffer action of soils. The soils of BURMA are being examined with a view to ascertaining their resistance to either sourness or alkalinity.

Soil moisture. The relation of the clay content of soils to their moisture adsorption is being studied at PUSA. It has been found that the relation between the two is of the nature of a log-log curve. It is, however, subject to a deviation due to variation in temperature and the character of individual soils. The work may possibly prove to be of some value in differentiating between varying types of soil.

Problems connected with the conservation of soil moisture under *barani* (only rain-fed) conditions are under investigation at Gurdaspur in the PUNJAB. Observations hitherto made indicate that a deep mulch may contain a lesser quantity of moisture in the first one or two feet, and that there is always a greater store of water or moisture under a deep mulch than under a shallow one.

Movement of nitrates. The study of the movements of nitrates in the soil and sub-soil at PUSA has now been carried through two complete years, comprising one very good and one very bad monsoon period. Observations made during both years point to the same conclusion, namely, that the distribution of nitrates in the sub-soil is determined by climatic factors and the physical character of the sub-soil layers, and that the growth of the crop in turn depends to a considerable extent on the distribution of nitrate. A mechanical analysis of soils and sub-soils down to 9 feet of all plots under observation has been completed. The analytical data obtained, is expected to afford a means of correlating the movement of nitrate and its concentration at various depths with the physical character of sub-soil layers. The investigation has this year been extended to a new series comprising (1) land permanently under pasture, (2) bare fallow land, (3) irrigated land, and (4) land under sugarcane. A similar investigation is being made by the scientific staff of the TEA ASSOCIATION in the tea districts.

II. Nitrogen Fixation.

Further observations on the conditions under which fixation of nitrogen by non-symbiotic organisms takes place have shown at PUSA that bonemeal gives higher fixation figures than the mineral phosphates, and that nitrogen fixation is increased by the addition of rotted organic matter to the soil, but that this increase is not obtained if excess of organic nitrogen is used, apparently owing to loss of nitrogen due to ammoniacal fermentation. As compared with cattle manure, fermented rice straw has been found to give larger yields both of maize and of oats grown as a second crop. Sugarcane trash added to the soil does not appreciably increase the rate of nitrogen fixation, but does so if previously treated with a bacterial inoculum in the form of a water extract of cow manure. Rice dust as an organic manure is liable to very rapid ammoniacal fermentation with consequent nitrogen loss, so that as a promoter of nitrogen fixation allowance must be made for such loss and ammoniacal fermentation reduced by proper attention to water supply.

Though the investigation into the underlying factors governing the nitrogen cycle in the soils of the PUNJAB has not yet yielded definite results, the field and laboratory work hitherto carried out indicate that normal soils possess the power of rapidly fixing large quantities of nitrogen without the addition of any carbohydrate; that under certain conditions, of which at present there is no exact knowledge, a loss of nitrogen can also rapidly take place; that light soils possess greater power of fixation than heavy soils and also suffer less from denitrification; but that on the whole fixation of nitrogen occurs more often than denitrification. The most important conclusion arrived at is that after the soil has been exposed to the climatic conditions for several months subsequent to the removal of the wheat crop, it becomes suitable for nitrogen fixation. A study of the micro-organic population (protozoa, bacteria, algæ and other closely related organisms) of the local soils has also been started, in order to throw light on their seasonal variations and relationship to the growing crop.

III. Manures and Fertilizers.

Farmyard manure. As the result of further work on the activation of nitrification in cattle urine, two methods have been devised at PUSA for conserving its nitrogen content. The first consists in the use of a suitably prepared aerating filter bed made of broken brick or rubble. The passage of the diluted urine through this bed results in the formation of nitrates and in the recovery of the major portion of the original nitrogen of the urine in this form. By the second method, soil prepared by previously nitrifying some nitrogenous material and washing out the nitrates is used for absorption of urine. If untreated ordinary soil is used, losses of nitrogen amounting to 70—80 per cent. of the original occur. It is estimated that in one year about 205 lb. of potassium nitrate can be obtained from a single animal's urine (containing about 1 per cent. nitrogen) by this process of intensive nitrification, provided no loss of nitrogen takes place during handling.

Experiments on a large scale were continued on the various farms in MADRAS to ascertain whether it is possible to devise a method of storing farmyard manure which is not too costly for the cultivators and which will reduce the loss of plant food to a minimum. The results hitherto obtained show that the box system, in which the manure is compacted by the animals themselves, is the best so far as the quantity, quality and cropping value of the manure are concerned.

Green-manuring. A result of immediate applicability was obtained at PUSA which indicates that a crop of sann-hemp can be made to serve a dual purpose by using it both as a green manure and as a source of fibre. This can be done by cutting off and using the tops of the plant as a green manure and retaining the stalks for fibre. Further work was also done in investigating the part played by soil bacteria, in providing available phosphate in the form of organic phosphorous compounds, as a result of the interaction of a green manure or other decomposing organic matter, and phosphatic manure such as superphosphate. Experiments on a quantitative basis showed that bac-

teria in cultures, both pure and mixed, are able to take up large amounts of phosphoric acid from various sources. This phosphate is then stored in the form of organic compounds as part of the bacterial cell.

It is generally conceded that superphosphate gives the best cropping value in calcareous soils at Pusa when combined with green manure. Starting with this idea mono- and di-calcic phosphates were separately composted with lucerne. It was found that inorganic phosphorous present in the above phosphates combines with the organic matter of lucerne and forms organic phosphorous compounds. It is probable that under natural soil conditions phosphates in organic combinations become more available to plants, and consequently contribute towards the better yield of crops as evidenced when superphosphate and green manure are applied together. The greater availability and efficacy of organic phosphorous to plants, as compared with inorganic phosphatic fertilizers as used in ordinary farm practice, is being studied. During the year experiments were also made to ascertain the effect of small quantities of sulphur (10 lb. to the acre) on green-manuring with sann-hemp (*Crotalaria juncea*). In the case of wheat it was found that the addition of sulphur markedly increased the efficiency of the green manure and gave a larger yield of seed and straw.

Sewage sludge. Experimental work in connection with the installation of an activated sludge plant for sewage disposal at JAMSHEDPUR has shown that this system of disposal is suitable both from the sanitary and the agricultural points of view. It produces a clear non-putrefactive effluent and a sludge rich in nitrogen and free from any offensive odour. The sludge has been used effectively for irrigating an area of poor gravelly (*moorum*) land. In one particular plot, four crops, *viz.*, oats, maize, beans and cabbages, were raised within the period of one year. A field of three acres of good paddy land, when irrigated with the sludge, gave an yield of 51,900 canes of J. 247 weighing over 50 tons per acre. In other experimental plots in which the value of sludge was compared with that of certain other

manures, the plot manured with 1,000 lb. activated sludge (50 lb. dry matter) and irrigated with the effluent gave a yield of green oats which was 26 times that of the check plot, and twice that of the plot which received 560 lb. of cattle manure. It is hoped that full advantage of these results will be taken by municipalities which are satisfied with their septic tanks and filter installations.

It has been found at the experimental sullage farm at LYALLPUR that sullage water is somewhat detrimental to wheat as it causes lodging, and is not beneficial to underground vegetables except when weak solutions are used. Crops requiring heavy vegetative growth such as cabbages, cauliflowers, maize and sugarcane, etc., are the most suitable ones to grow under these conditions.

Organic manures. The influence of the moisture content during the rainy season on the ammonifying and nitrifying power of black cotton soil is being investigated at NAGPUR. The results indicate that a moisture content of 24—30 per cent. enables the soil to attain its maximum biological activity as regards nitrification, and that with the temperature fluctuating between 75° and 95° F. during the monsoon months, 50—60 per cent. of added nitrogen in the form of oil-free sesamum cake is oxidized in two weeks.

The decomposition of different cake manures under field conditions in the red soils of BENGAL is being studied at Dacca. With a moisture content kept more or less constant between 14 and 16 per cent. the nitrification of castor and mustard cake was progressive for the first two months, at the end of which it was 50 per cent. It then slowed down and after four months amounted to 56 and 55 per cent., respectively. Sesamum, safflower and groundnut cakes gave progressive figures of 58, 69 and 76 per cent. respectively.

The nitrification of bone manures, which is ordinarily a very slow process in most Indian soils, was the subject of investigation at PUSA. It was found that rapid and complete nitrification of this refractory material could be obtained by fermenting it before applying it to the soil.

Nitrate of soda. Experiments to ascertain the effect of nitrate on a crop of wheat when applied at different stages of its growth were continued at PUSA. As the addition of nitrate eighteen weeks after sowing produced no effect, it was decided to use the nitrate only at three stages, *viz.*, at the sowing time and at intervals of six and twelve weeks after sowing. In order to study the effect of nitrate passing down to different depths, varying amounts of irrigation water were given. The results so far obtained show that irrigation to the extent of 2 inches does not influence the nitrogen content of the wheat, the percentage of nitrogen in the crop from unirrigated and unmanured plots being the same as the percentage from irrigated and unmanured plots of the same season. It was further noticed that the application of nitrate of soda at any time up to 12 weeks after sowing resulted in an increase of nitrogen in the grain.

Phosphates. The method under trial at PUSA of making mineral phosphates available by natural bacterial processes was extended to bonemeal. A composition of bone dust, sulphur and sand inoculated with a mixed culture of sulphur-oxidizing bacteria was found to contain citrate-soluble phosphoric acid to the extent of 94 per cent. of its original content after a period of 23 weeks fermentation. It was found that an excess of sulphur as compared with phosphate (as bonemeal) in the compost was preferable to the reverse; thus by the gradual addition of bonemeal to the compost better results were got than by the gradual addition of sulphur, the total relative final amounts remaining the same.

Some special manurial experiments carried out in the paddy fields of the Tanjore delta in MADRAS, to test the economic value of Trichy flour phosphate as compared with bonemeal applied along with various organic manures, showed that there was not much to choose between the two, nor between the various sources of organic materials tested. It further appears that while nitrogen *plus* phosphate gives a better yield than phosphate alone, the addition of green manure gives the maximum yield. In the South Bhagalpur soils of BIHAR, Trichy phosphate and castor

cake did not produce an increased yield of paddy, though the former contained 24 per cent. of phosphoric anhydride of which 13 per cent. was soluble in ammonium citrate.

Lime. Further work in BENGAL on the effect of liming red laterite soils has definitely established the fact that the addition of lime above a certain maximum tends to throw the potash out of solution. On treating a red soil solution with bone and lime, the further application of the latter tends to increase the phosphate in solution; but an increase in the quantity of bone seems to decrease the lime in solution.

IV. Sugarcane.

The nature of the enzymes inducing deterioration of windrowed canes and the mechanism through which their activities become effective were under investigation at PUSA. The experimental results hitherto obtained have indicated that sugarcane windrowed in the field immediately deteriorates on the incidence of rain, owing to the quick passage of water through the nodes of somewhat dried canes. The enzymes (invertase) inducing deterioration are localized in certain portions of the cane, particularly in the nodes, and normally do not affect the juice contained in the internodes. Experimental windrowing of canes was also carried out at DACCA where both the yield and the quality of the juice were found to have been adversely affected.

The results of an investigation carried out at COIMBATORE into methods of testing the ripeness of sugarcane have been embodied in a Pusa Memoir (Chemical Series, Vol. VII, No. 6). They indicate that cane ripens joint by joint and that the most suitable time for cutting the crop is when the top, as well as the bottom joints, show refractive indices, the ratio of which is close to unity. It has also been found that the coefficient of purity is not a reliable criterion by which to judge the ripeness of a cane.

V. Sugar-beet.

Experiments with sugar-beet were carried out at PUSA during the year under review. The out-turn from different plots varied from 10·5 to 11·8 tons per acre, and the percentage of sucrose in the juice from 14·8 to 15·3.

VI. Animal Nutrition.

The transfer of the Physiological Chemist to the newly established Imperial Institute of Animal Husbandry and Dairying at BANGALORE in the middle of the year necessitated the discontinuance of the experiments started at Pusa. He, however, initiated during the latter part of the year experiments on the production value of certain rations in co-operation with the Madras and Mysore Departments of Agriculture. Important work on this subject is also being done at LYALLPUR; the central idea is to discover, by chemical analysis and actual feeding tests on animals, the nutritive values of the different local crops and their products. When data as to their nutritive values are available, it will then be possible to work out the most economic diets on the basis of the prices at which they are available. The principal investigations in progress at Lyallpur relate to (*a*) the variations in the nutrient constituents of growing wheat and oats, (*b*) the proteins in wheat, (*c*) the effect on milch cows of siloed *shisham* (*Dalbergia sissoo*) leaves when used as a substitute for green fodder, and (*d*) the digestibility of *shisham* leaves, green sarson, *bhusa* and gram.

VII. Milk.

It was noticed that the percentage of fat varied from 3·0 to 7·5 in the case of the two Montgomery and from 2·8 to 8·6 in the case of the two cross-bred cows tested at PUSA, and that the variation beween the morning and evening milk of the same cow was from 3·0 to 7·0. It was also observed that there was a gradual rise in the fat content between the fifth and the seventh month after calving, followed by a slight fall to-

wards the close. Similar analysis carried out at SABOUR disclosed large variations in the fat content during the hot weather.

VIII. Preparation of Malt from Sorghum.

Large scale experiments on the malting of sorghum, which may be considered as intermediate between laboratory experiments and factory operations, were carried out at Coimbatore at the instance of the Director of Industries, Madras. The results definitely indicate the possibility of controlling the temperature and malting sorghum satisfactorily on a large scale.

IX. Alcohol from Tamarind.

The utilization of tamarind pulp as a source of alcohol and tartaric acid is being investigated in the UNITED PROVINCES. From the analytical data it appears that the predominant constituent of the pulp is sugar, which, if first converted into alcohol, would place the manufacture of tartaric acid on a sound commercial basis. Fermented by the organisms naturally present, the pulp yielded 10·79 per cent. (by weight) of absolute alcohol; but with pure cultures of yeast, the extract was as much as 19·26 per cent. Fermentation was found to be at its best when the ratio of pulp to water was between 1 : 3·5 and 1 : 5, and the higher the temperature nearing 40°C., the better and quicker was the alcoholic fermentation.

X. Lathyrism.

The botanical work in connection with a detailed investigation, under the auspices of the Indian Research Fund Association, of that form of paralysis known as lathyrism was continued at PUSA during the year. The unit species of *khesari* (*Lathyrus sativus*), the long-continued consumption of the seeds of which is popularly believed to be the source of the disease, have been isolated and a tentative classification of these forms has been made. The four leguminous weeds found mixed with various

samples of *khesari* obtained are—*Vicia sativa*, *V. hirsuta*, *Lathyrus sphœricus* and *L. aphaca*. The seeds of these weeds are being multiplied for the various experiments planned on the chemical and medical sides of the investigation.

XI. Kala-azar.

During the last few years Pusa and the surrounding district has become a centre of Kala-azar infection, and this has very naturally induced the staff of the Institute to interest themselves in the search for the carrier of the disease. Consideration of the data on the distribution and transmission of Kala-azar has led the Imperial Entomologist to suggest species of *Culicoides* as vectors of this disease, while the Imperial Agricultural Bacteriologist carried out important work during the year on the cytology of the bed bug—a possible source of infection.

XII. Diseases of Crops.

The practical methods adopted for combating the ravages of diseases attacking the more important crops have been indicated in the previous chapter. It is proposed to deal here with such investigations as have not yet reached the stage of practical application.

At PUSA, the possible connection between *Helminthosporium* and a foot rot of wheat was investigated, but so far inoculation experiments have not given conclusive results. In actual practice, treatment of oats with a 0·25 per cent. solution of formalin has been found to be an effective preventive against smut. Progress was made in elucidating the factors governing the pigeon-pea wilt problem and in interpreting the data given by the existing field experiments. That the amount of wilt due to seed-borne spores is small has been proved by experiment. It has also been ascertained that disease " extends " to a distance of nine feet in a season. The existing field plots having been found inadequate for ascertaining the relation between the incidence of

disease and different manures, a new series has been laid down to test the effect of superphosphate and green-manure in this respect, when applied to a wilt-infected soil.

Work on the identity of the fungus causing stem rot in jute was brought to a conclusion. The fungus which has been identified in Japan as *Macrophoma Corchori* appears to be identical with that which has been worked with in this country as *Rhizoctonia Solani*, while cultures of the sclerotial stage sent to America have been pronounced to be identical with *Sclerotium bataticola*. The incidence of *M. Corchori* has been found to be largely dependent on the amount of potash available in the soil. The behaviour of *Fusarium udum* to phosphate and of *Macrophoma Corchori* to potash was studied in liquid culture media of known chemical composition with a view to determining the relationship of the fungi to the various concentrations of these chemicals.

Inoculation experiments carried out with the fungus *Metarrhizium anisopliæ*, which was found attacking rhinoceros beetle grubs in Burma, gave cent per cent. infection. The grubs became paralysed in 24 days and gradually died. When tried in manure-heaps, the fungus was not found very efficient in killing the grubs, but a better knowledge of the habits of the host may lead to more certain results.

A wide-spread disease of the betel-vine plantations reported from Bengal is under investigation at Pusa. The intensive nature of the bacterial infection suggests the burning of the soil with the whole of the plants and other appurtenances used in these plantations as the only possible and immediate remedy, the alternative being a prolonged period of rotation and fallowing.

In MADRAS, further study of the disease which causes the shedding of leaves of sorghum has shown that it is not seed-borne but is due to soil infection. Initial experiments conducted with Germisan as a preventive of short smut on the same crop have given satisfactory results, and it is proposed to try it on a field scale. The species of *Phytophthora* which

causes the *mahali* disease of arecanuts has been found by inoculation experiments to cause a nut-fall of coconut.

The storage rots of potatoes, cotton wilt and cotton boll-shedding are the principal diseases under investigation in BOMBAY. Investigations carried out during the past few years indicate that the storage rots of potatoes may be divided into dry rots caused by fungi, and wet rots caused by bacteria. Unaccompanied by bacteria, each of the four kinds of fungi, hitherto identified, produces a characteristic form of dry rot; but the individuality of the rot is often lost owing to bacterial invasion and it ultimately becomes a wet rot. All these fungi appear to attack the potato tuber ordinarily through wounds in the skin; but they may occasionally also find admission through lenticels and through the interruptions in the skin in the neighbourhood of the eyes. The fungi grow fairly well between temperatures of 77° F. and 95° F., while the optimum temperature for the growth of bacteria is between 86° F. and 104° F. At Dharwar, a selection from local Kumpta and a strain of Burmese cotton have proved resistant to cotton wilt. It, however, appears that varieties which have the reputation of being immune from this disease in one locality do not maintain their immunity when grown in another. There is at present no evidence as to whether this variation in behaviour is due to differences in the active exciting cause, or merely to differences in the environment under which the crop is grown.

Researches carried out in the CENTRAL PROVINCES on the wilt disease of cotton indicate that wilted plants contain a higher proportion of aluminium than healthy plants, and point to the toxic effect of aluminium as the primary cause of the disease, fungi being possibly secondary agents.

The degree to which the sandal tree is parasitic on other plants is the subject of an investigation in MYSORE. An examination of the haustorial connection has shown pretty clearly that the sandal tree gets most of the nourishment which it requires from the soil by way of the roots of its host plants. Appreciable quantities of strychnine have also been found in various parts of a sandal tree which was growing parasitic on *S. nuxvomica*.

XIII. Insect Pests.

The measures adopted against important pests of field and garden crops have been referred to elsewhere and need no recapitulation. A large amount of useful observations relating both to the behaviour of insects known to affect crops and to their parasites have been made at Pusa and in the provinces. These are referred to below.

At PUSA, the investigation on borers in sugarcane and gramineous plants was continued and a large number of pests were reared in the insectory, but no new species were found. The fruit pests of Kashmir were specially studied from May to October 1923, and a report submitted to the State Durbar. It has since been reported that the spraying fluid recommended (a preparation of fuel oil, rosin, soap and tobacco waste) is giving hopeful results in controlling the San Jose Scale. Work on pathological entomology was continued with special reference to veterinary subjects. The life-histories of various species of Tabanidæ have been worked out and further work has also been done on the biology of the local Culicidæ. The transmission of rinderpest by means of *Stegomyia* and *Musca domestica* is being investigated in collaboration with the Muktesar laboratory. From specimens of warble-flies collected in Northern India, it appears that the fly attacking cattle in India is *Hypoderma lineatum* and not *H. bovis* as was supposed hitherto. Considerable progress has been made in the preparation of a treatise dealing with the insect pests of domesticated animals for the use of veterinary officers and students.

The investigation into the control of *Siga incertellus*, the paddy stem borer, was hampered in MADRAS; the dry condition of the year was unfavourable to its incidence. It has been discovered that the chief food plants of the fruit moths (*Ophideres materna*, *O. fullonica* and *Anua coronata*), which are responsible for considerable damage to fruit trees in the Kistna District, are mostly common weeds. When these weeds are eradicated the damage is greatly diminished, as the caterpillars being starved do not develop into moths. The control of hairy caterpillars by hand-picking has been found to be a practicable proposition.

The work done at Surat in BOMBAY PRESIDENCY seems to suggest the cultivation of the parasite *Microbracon lefroyi* as the most promising method of dealing with the spotted bollworm pest in Gujarat.

Pests of cotton, sugarcane, fruit trees and stored grain are being studied in the PUNJAB. Of the several methods tried for the destruction of borers in gramineous plants, the turning in of the stubble sheltering them has been found very effective. Fumigation of grain stores with hydrocyanic acid and carbon bisulphide has given good results; superheating is also being tried effectively to sterilize wheat godowns. Poison-baits of strychnine and arsenic and fumigation with carbon bisulphide have been found effective means of rat destruction, the cost ranging from As. 2 to As. 6 per acre.

In the UNITED PROVINCES, the members of the entomological staff are engaged almost exclusively on the study of cotton bollworms. Much necessary preliminary work has been done, and 14 acres of field experiments have been laid down with treated seed.

XIV. Useful Insects.

Bees. The Entomological Section at Pusa continued to deal with enquiries regarding bee-keeping; but as previously remarked, the subject of apiculture in India requires the services of a whole-time expert if the work is to be taken up seriously.

Lac. The June crop was adversely affected on account of the unusually fierce heat and the outturn was very poor; such *ber* (*Zizyphus jujuba*) brood-lac as was available was sent out from Pusa to various applicants from different parts of the country. The seasonal appearance and extent of parasitization of the Noctuid moth (*Eublemma amabilis*), which is responsible for considerable damage in lac plantations, was studied. The search made for its alternative hosts has not hitherto been successful, though *Eublemma* sp. (near *trifasciata*) was again bred from *P. corymbatus* on cotton shoots. A study of the parasites has also been taken up, and an Encyrtid has been found

to parasitize the adult females of the June-July crop to a very large extent. The work on lac research will be considerably developed as soon as the laboratories of the Indian Lac Association at Ranchi are equipped with fittings and staff.

Silkworms. With the abandonment of all work on hybridization of silkworms in BENGAL, the hill nursery at Kurseong is being utilized for the improvement of the local races by selection. It is mainly concerned with the rearing of the Chotopolu which is a delicate race; it has been arranged that the hill-reared crop of March-April should be transferred to the plains for rearing during September-October. The breeding work on the Nistari worm, which is less susceptible to the attack of pebrine, is carried on at the Alipur nursery which has the distinct advantage of being far from the centre of infection. Although mulberry plantations were adversely affected in the year under report by a prolonged drought, the demand for Government seed was as keen as ever. The sales from nine nurseries amounted to Rs. 75,230 as against Rs. 61,188 in the previous year. In addition, 12,000—15,000 *kahans* of disease-free cocoons were issued from 36 private seed farms working under the supervision of the department. Eleven students passed out of the Berhampur and Rajshahi sericultural schools, while eight ex-students were granted the reward of Rs. 250 for the construction of model rearing houses, on condition that they would work as approved seed-growers under departmental supervision for a period of five years.

In MADRAS, the Department of Industries, which is in charge of the sericultural work being done in the Presidency, is supplying disease-free seed and testing new methods of reeling silk.

In the PUNJAB, 1,500 oz. of silk seed was distributed among 953 rearers as against 1,392 oz. among 608 rearers in the previous year, and a record yield of $7\frac{1}{3}$ tons was brought to the auction. Propaganda work was extended to 42 new villages, while 445 new rearers were trained. Over 10,000 new mulberry seedlings were planted on canal banks, and 4,400 were distributed among private persons and schools. Eighty-five schools have now introduced silkworm rearing, and the prizes for the two highest

yields went to teachers who produced 46 and 44 lb. of cocoons per oz. of seed respectively.

The importation of univoltine races of silkworms into BURMA has not proved a success, and the department is therefore concentrating on the work of distributing disease-free eggs of the local variety. Altogether 5,200 layings of examined seed were supplied to the rearers of Paukkoung, but this quantity fell far short of the demand. It is therefore proposed to establish a local nursery to cope with it. The number of trained rearers has risen to 116 who have 80 acres under mulberry.

In spite of adverse climatic conditions, the grainages in MYSORE issued nearly 2½ lakhs of layings, while the aided rearers of two centres distributed about seven millions of seed cocoons. Experiments are in progress to fix new and more productive races with the best qualities of the local silkworms. On the whole, F_1 hybrids obtained by back crossing with the Mysore race seem easier to rear. They give more uniform results than the fixed races by themselves.

CHAPTER IV.

AGRICULTURAL ENGINEERING.

The work of the Engineering Sections of the Provincial Agricultural Departments is directed mainly towards (1) developing and increasing the water supply from wells by sub-artesian bores, and (2) designing and testing agricultural implements. The question of substituting power pumps for water-lifts driven by bullock or man power is one of capital which few cultivators are able to provide. It is, however, gratifying that in at least one province as many as 48 tube wells complete with power pumping plants were put down in a single year.

The introduction of improved tillage implements from the West has done much to raise the standard of farming in this country. The efficiency of many of these implements is due to their having been designed by the trained engineers of certain firms working in collaboration with agricultural experts in India. The pioneer work done by the Agricultural Department in this direction has borne fruit, and thousands of improved agricultural implements are now to be seen in the country-side. The sales made through the agency of the department (Appendix IV, p. 123) represent only a fraction of the total number sold, as the sales through non-official agents are not taken into account. The growth of the demand can well be gauged from the fact that one pioneer manufacturer in Bombay Presidency has a factory with a daily output of 200 ploughs alone which are all sold in the country. India still wants drills, mowing machines, fodder cutters, threshers, winnowing machines and cane mills designed to meet the varying needs of different parts of the country and the very low purchasing power of the tillers of her soil. Now that most of the Agricultural Departments have an Agricultural Engineer on their staff, the designing of cheaper and more suitable implements has become a matter of time, and it can be confidently

expected that some of the promising designs now under trial will meet the requirements of the Indian cultivator.

In **Bombay Presidency,** 127 successful bores were made during the year. The department has also begun land improvement work in the Southern Division, and a special development officer has been added to the staff. He has prepared during the year 34 bunding schemes for the Dharwar and Bijapur Districts, of which 11 are already under construction.

Helped by a fall in the price of stores, the re-organized engineering section in the **United Provinces** did particularly well during the year under report. The number of tube wells with pumping plants successfully completed during the year was 48 as against 16 in 1922-23. The expenditure of about Rs. 12,000 required for the construction of these large tube wells with pumping installations limit their use to individuals possessing capital. A small, cheap and durable type of strainer tube has, therefore, been invented, which, while yielding 15,000 gallons per hour, costs only about Rs. 3,000 including the price of a 7 B. H. P. oil engine.

In the **Punjab,** the number of bores sunk amounted to 248 as compared with 301 during the previous year, but the percentage of successful bores rose from 80·22 to 83·0. Improvements have been made in the department's new iron Persian wheel during the year, and some test wheels are now working at depths of over 63 feet.

The Agricultural Engineer in **Burma** has designed two *jaggery* furnaces with fire-box, flues, etc., so arranged that, by careful stoking, they can be run on megass alone. He has also designed three types of plough shares which, when fitted on to the ordinary Burmese plough at a cost of about Rs. 4, can give as good work as some of the imported ploughs costing Rs. 32-8 and over. An improved water lift constructed on the screw principle gives with a 3 feet head 5 gallons of water per revolution. When fitted with a wind-mill at the total cost of Rs. 45 it gives a discharge of 200 gallons per minute. Another type designed for lifting water from a flowing stream is worked by means of paddles fitted to its circumference. It has been found

to discharge 100 gallons per minute at a 12 feet head. These lifts are simple in design and can be made by the village carpenter.

As the post of Agricultural Engineer remained vacant in **Madras** owing to lack of funds, no progress could be made in designing new implements. Three hundred and fifty-four wells were successfully bored by the Industries Department to which this work has been transferred.

Competent authorities are reported to have expressed the view that the introduction of the new **Mysore** plough marks a distinct advance on the road of adapting improved implements to Indian conditions, and it is expected that it will meet the needs of the majority of agriculturists in the State much better than any plough which has been previously tried. The failure of the monsoon and the attendant limitation of tank irrigation during the year in parts of the State, forced upon the attention of the department the necessity of organizing a well boring section which, during the five months of its existence, put down 30 bore holes and assisted in the construction or improvement of 35 wells.

The Alwaye and the Pallikkal ploughs designed by the **Travancore** department are gaining in popularity.

Out of 110 bores sunk during the year in **Baroda,** 70 were successful.

Motor tractors. Reports from different provinces indicate that tractors are specially useful for two purposes, *viz.*, for light and shallow cultivation on large estates when a considerable area has to be dealt with in the minimum time, and for clearing lands infested with obnoxious weeds such as *Saccharum spontaneum.* In the Central Provinces, the cost per acre of ploughing stiff soil badly infested with weeds comes to Rs. 30 when done by tractors, while the cost of hand-digging amounts to Rs. 80 per acre. As at present designed, the tractors are, however, not sufficiently strong and fool-proof for Indian conditions, and the difficulties of keeping them in good running order are enhanced by the absence of workshops and by the delay in getting spare parts. That tractors can be used with

advantage both for ploughing and cultivating land and for driving stationary machines has been proved; what is now required for their wider use is the organization of repairing centres fully stocked with spare parts and staffed by trained mechanics.

CHAPTER V.

DISTRICT WORK.

In India, Departments of Agriculture play many parts. Their scientists evolve improvements, and then test them under varying soil and climatic conditions before recommending them. This very important part of the work of departments is done mainly on experimental farms and in laboratories. Their district workers play an equally useful part in getting the cultivator to adopt these improvements. This involves the opening of Government seed and demonstration farms. It involves, too, the creation of a big organization including village demonstration plots and seed farms, agricultural associations, co-operative societies, agricultural shows, lectures, ploughing matches, and the dissemination of information regarding improved methods of husbandry generally. In the more advanced provinces the work of the Department of Agriculture is thus a great economic and educative force. The success attained by this complex machinery in bringing millions of acres under improved varieties of crops and thousands of improved implements into daily use will be manifest from Appendices I and IV (pp. 107 and 123).

The changes introduced in the organization for district work in **Bombay** in 1921-22 provide for closer co-operation between the Agricultural and Co-operative Departments, the institution of divisional boards to control the propaganda activities of both departments, and the definite adoption of a system of local development associations for carrying on agricultural propaganda in areas which desire it. The divisional boards which exercise control over all current work in the districts are reported to be doing good work. The formation of *taluq* agricultural associations has been taken up with much enthusiasm; their number has reached a total of 38—an addition of 27 for the year. Each association receives as a subsidy from Government a sum equal to that raised locally, subject to a maximum of Rs. 2,000. These bodies are of great

potential value in providing a local agency for introducing improvements recommended by the department. For the supply of improved seed, the department controls large areas in selected parts of the presidency; those for cotton alone amount to some 15,000 acres. During the year under report, $1\frac{3}{4}$ million lb. of cotton seed were available for distribution in the Surat area. The department has also been maintaining depôts for the sale of improved implements; but this work is now slowly passing out of its hands into those of societies and private individuals who have begun to see money in this business.

A most satisfactory feature of district work in **Madras** is the establishment of demonstration plots on the ryot's own lands. In all about 600 plots of this kind were in existence during the year, and although it is not claimed that all of them met with unqualified success, the majority of them served their purpose. For example, plots designed to demonstrate the benefits derived from the economic planting of paddy gave an additional profit of Rs. 18 to 25, while the use of oil-cake and bone-meal in conjunction with green manure had an advantage of Rs. 38 per acre over the local method of manuring paddy fields. The popularization of the growing of green manures on wet land, after the harvest of paddy, achieved success, and over 100 tons of sann-hemp, *dhaincha* (*Sesbania aculeata*) and *kolinji* (*Tephrosia purpurea*) seed were sold to cultivators during the year under review. A systematic campaign conducted in selected areas resulted in the erection of 395 McGlashan *gur* furnaces in Chittoor District alone. It may be noted here that this type of furnace designed in the Central Provinces some years ago by Mr. McGlashan has since been introduced in different parts of India. This simple invention must now be adding lakhs a year to the farming profits of cane-growers, for it is reckoned that its adoption adds as much as Rs. 90 per acre to the net profit on cane cultivation. Spraying machines capable of dealing with 138,200 trees were sold as the result of strenuous propaganda carried out by the department with a view to popularizing the advantages of spraying arecanut palms against *mahali* disease.

The demand for seed of departmental varieties of jute, paddy and sugarcane in **Bengal** was as insistent as before. Sixty tons of jute seed were sold and nearly 11 tons distributed in small packets from the Government depôts. It is estimated that nearly one-tenth of the whole area under jute was sown with what is popularly known as *Sarkari beej*. The acreage under Tanna sugarcane is reported to have increased about twenty-fold during the last four years. Retrenchment in expenditure has necessitated a reduction in the district staff, but several Khas Mahal and Court of Wards estates continued to supplement the activities of the department by running their own demonstration plots. It is also gratifying to note that three leading zemindars have started private farms which have already been the means of introducing departmental crops on a considerable scale in their neighbourhood.

During the year under review, seeds of Kakya Bombai jute, Dahia paddy, Pusa 12 wheat and Coimbatore canes were distributed on an increased scale in **Bihar and Orissa.** The cultivation and ploughing in of *dhaincha* as a green manure for paddy, in combination with superphosphate, proved an effective demonstration in the Bhagalpur Division, and its general adoption is believed to be only a matter of time.

Ninety departmental stores were at work in the **United Provinces** during the year under review, and supplied 2,092 tons of seed, 1,700 implements and 120 tons of organic manures. A feature of the district organization in this province is the establishment of private farms by wealthy zemindars. During the last three years the number of such farms has risen from 202 to 405, of which 51 are 100 acres or more in area. They serve both as seed depôts and as centres from which improved methods spread to surrounding cultivators. Demonstrations were conducted by the staff during the year on 56,910 acres; it is calculated that over 250,000 acres have been thus brought under the direct influence of the department within the last few years.

In the **Punjab** about 550 tons of wheat and 1,220 tons of cotton seed were sold during the year from the seed depôts.

From similar depôts for the sale of agricultural implements, over 10,000 implements and parts of implements were disposed of. The work of the department is increasing in popularity and agricultural shows and ploughing matches are now attracting more attention in rural areas.

Over 7,850 tons of improved seed were distributed as against 5,100 tons in the preceding year from Government and private seed farms in the **Central Provinces.** The demand for improved agricultural implements in this province is equally significant; over 8,000 ploughs of the total value of Rs. 3,00,000 having been sold during the year.

The efforts made under the direct control of Government for the spread of agricultural improvements are ably supported by non-official bodies such as agricultural associations, co-operative shops and seed associations, some of which are maintaining their own staffs for propaganda. The co-operative associations in Berar alone now number 42. With a share capital of Rs. 50,000 they made a profit of over Rs. 17,000 for the year.

The outstanding feature of district work in **Burma** was the organization of private seed farms. They are owned mainly by chairmen or members of co-operative societies and vary in size from small areas of about 10 acres up to a hundred or more. It augurs well for the scheme that as many as 83 farms are already at work. In some districts, the formation of agricultural unions has been attempted. In this case the unit organization is the village or group of neighbouring villages. In the Meiktila District alone, nine such unions with a total membership of 378 were formed during the year. The total quantity of seed distributed from Government and private farms was 852 tons, of which over two-thirds was represented by different varieties of paddy. It is estimated that this effort was helpful in increasing the area under pure seed by over 43,000 acres.

Demonstrations were conducted on small plots placed at the disposal of the department by cultivators or rented for the purpose. About 100 plots designed to demonstrate the growing of improved varieties by better methods of cultivation attracted considerable attention in the surrounding localities. The

township committees of prominent landowners and farmers formed with the object of discussing agricultural problems with the officials of the department have not proved a success, and it is proposed to replace them by village associations, each with its own seed farm.

Seeds, manures and implements of the value of Rs. 59,892 were issued from the three depôts in **Assam.** The most important of the articles supplied were 78 tons of Shillong potatoes, 34 tons of paddy, 95 tons of bonemeal and fish-manure, and 182 sugarcane mills. Successful demonstrations were carried out on cultivators' plots in several parts of the province with improved potatoes, selected strains of paddy and superior varieties of sugarcane.

About 30 tons of seed of Pusa 4 wheat, Assam Red sugarcane and berseem were distributed by the department in the **North-West Frontier Province.**

Close co-operation has been established between the Agricultural and Co-operative Departments in **Mysore,** where the services of the co-operative societies are being utilized more and more for the sale of implements, seeds and manures. During the year under report 90 societies rendered useful service in this direction. Over 40 tons of *ragi*, 15 tons of paddy, 5 tons of groundnut, 240 tons of manures and 17 lakhs of sets of sugarcane were distributed. The members of the Agricultural and Experimental Union are very helpful in supplementing the demonstration work carried out by the department.

In addition to about 40 tons of rice seed, 7,000 coconut seedlings and 14,000 coconut seeds were distributed in **Travancore.** The sales from 50 departmental and other manure depôts amounted to Rs. 10,000.

Propaganda work in the **Baroda State** is devoted to the spread of 1027 A. L. F. cotton and Pusa 4 wheat; over 75 tons seed of which were sold during the year.

The distribution of pure seed of the long stapled Gaorani cotton on the *takavi* system formed the principal item of district work in the **Hyderabad State.** It is estimated that nearly four lakhs of acres were grown from this pure seed.

Over 40,000 fruit trees were ready for distribution in the state nurseries in **Kashmir,** but as most of them were affected by the San Jose Scale, only 7,500 pest-free plants were issued to local zemindars.

CHAPTER VI.

AGRICULTURAL EDUCATION.

While the year 1922-23 was marked by the closing down of the Agricultural College at Sabour owing to the poor demand for **higher agricultural education** among the people of the province of Bihar and Orissa, the year under report saw the opening of two first grade institutes, *viz.*, the Provincial Agricultural College at Mandalay and the Imperial Institute of Animal Husbandry and Dairying at Bangalore. Thus, in addition to the two Imperial institutes at Pusa and Bangalore, which provide facilities for post-graduate courses, we have now six provincial colleges at Poona, Coimbatore, Lyallpur, Cawnpore, Nagpur and Mandalay, of which the first three are affiliated to Universities. The three eastern provinces of Bengal, Bihar and Orissa, and Assam, with a united population of 90 millions, are the only ones without an institution imparting higher education in agriculture.

The AGRICULTURAL COLLEGE AT POONA entered the sixteenth year of its existence. The number of students on the roll was 173, of which 23 per cent. came from the four chief agricultural communities of the Presidency. The results of the university examination were on the whole satisfactory; out of 68 candidates for the degree of B.Ag., 55 passed.

The withdrawal of stipends and the reduction in the number of trained men now being given appointments in the department accounted for a falling off in the number of applicants for admission to the three-year B.Sc.Ag: degree course of the AGRICULTURAL COLLEGE AT COIMBATORE. Out of 68 applicants, as against 126 for the previous year, a full first year class was formed; but only seven actually joined and of them two resigned early in the session. The results of the university examinations were, however, less disappointing than in the previous year; 19 students appeared in Part I and 14 passed, while all the eight who appeared in Part II were successful. The two-year certificate course also failed to secure a sufficient

number of students, and a class of 12 only could be made up by admitting three students whose educational qualifications were below the required standard. There were 24 students in the second-year class, of whom 20 were awarded the certificate. The course has failed to gain popularity and it has been decided to replace it by a special Intermediate course with agriculture as the main subject. The scheme is now awaiting the sanction of the Madras University.

The increasing difficulty felt by agricultural graduates in getting Government employment is supposed to have played an important part in reducing the number of applicants for admission to the degree course of the AGRICULTURAL COLLEGE AT LYALLPUR from 300 to 180. It has therefore been decided to give preference in future to the alumni of the college in filling certain Government posts in the Irrigation and Co-operative Departments for which a knowledge of agriculture is required. With a view to giving an impetus to agricultural education by encouraging agricultural graduates to undertake farming on their own account, a carefully planned scheme for leasing out 50 farms of 75 acres each to agricultural graduates of the Lyallpur College for a term of 5 years has been submitted to the Local Government for consideration. Of the 39 students who appeared at the university examination, 26 qualified for the degree; while out of seven candidates only one failed to obtain the certificate.

The AGRICULTURAL COLLEGE AT CAWNPORE which provides two courses—the diploma course of four years and the vernacular course of two years—also reports a drop in the number of applicants for admission. There was, however, no difficulty in selecting 21 students of the required calibre for the senior and 24 for the junior course. In the annual examinations, 11 out of 12 students obtained the diploma, while of the 26 examined 20 secured the certificate.

A slight extension of the present diploma course and small additions to the staff are required to allow the AGRICULTURAL COLLEGE AT NAGPUR to be affiliated to the local University, and it is anticipated that in the forthcoming year the college will

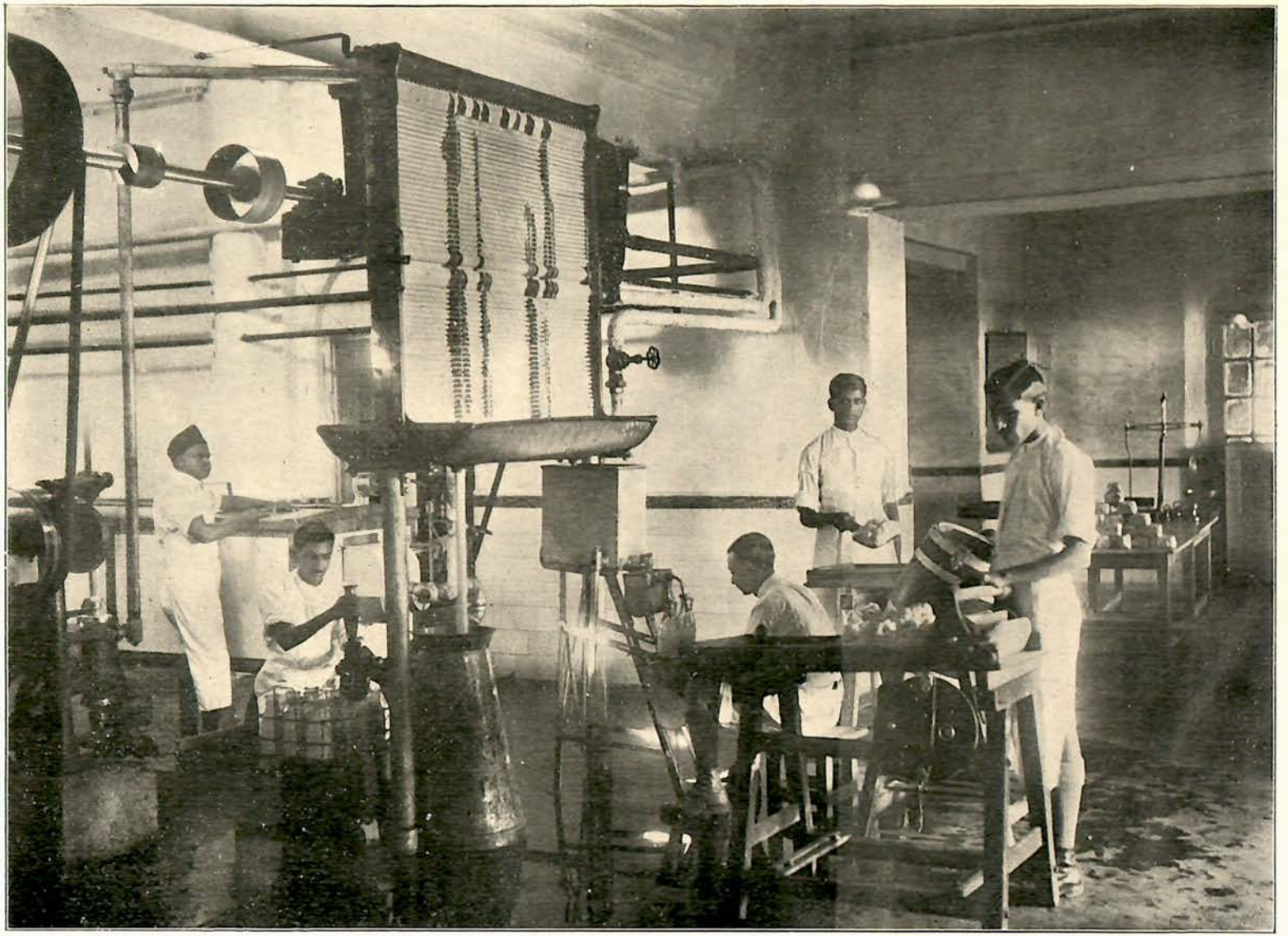


PLATE III.

DAIRY DIPLOMA STUDENTS AT WORK.

Pasteurising and bottling milk and butter making at the Imperial Institute of Animal Husbandry and Dairying, Bangalore.

be training its students for a university degree. The affiliation will not affect the 2-year certificate course in practical agriculture, which will be continued on its present lines. Of the 83 students on the roll during the year, 23 were from areas outside the Central Provinces and Berar. In the final examinations three students obtained the diploma, and 13 the certificate.

The newly-opened AGRICULTURAL COLLEGE AT MANDALAY has begun work with 24 students, each of whom gets a monthly stipend of Rs. 50. The standard for entrance is the High School Final. Students possessing this qualification will be allowed to go in for the degree of B.Sc. in Agriculture, when the college is affiliated to the Rangoon University.

As stated in last year's report, post-graduate courses in Agricultural Chemistry, Botany, Mycology, Agricultural Bacteriology and Entomology, each extending over two years and qualifying for appointments in the Indian Agricultural Service, were started at the AGRICULTURAL RESEARCH INSTITUTE AT PUSA from 1st November, 1923. There were 40 candidates for admission. Out of these the Selection Committee selected two possessing the necessary qualifications and they are now undergoing training in Botany and Entomology. In addition to these, one student was admitted during the year to a one-year course in Entomology, while six students who joined during the previous year continued to receive training in the following subjects: Botany 1, General Agriculture 1, Entomology 1, and Agricultural Bacteriology 3. Two students took short courses in Mycology, three in Entomology and two in Lac-culture.

The fifteen-month post-graduate course in animal husbandry and dairying started on 2nd January, 1924, at the IMPERIAL INSTITUTE OF ANIMAL HUSBANDRY AND DAIRYING AT BANGALORE with a view to training men for posts of Deputy Directors of Agriculture and Professors of Agriculture is being taken by five students—two from Bombay and three from the Punjab. In connection with the working of the Bangalore Institute, Government have also instituted an Indian Diploma in Dairying on the lines of the British National Diploma in Dairying, to be granted to persons who have successfully com-

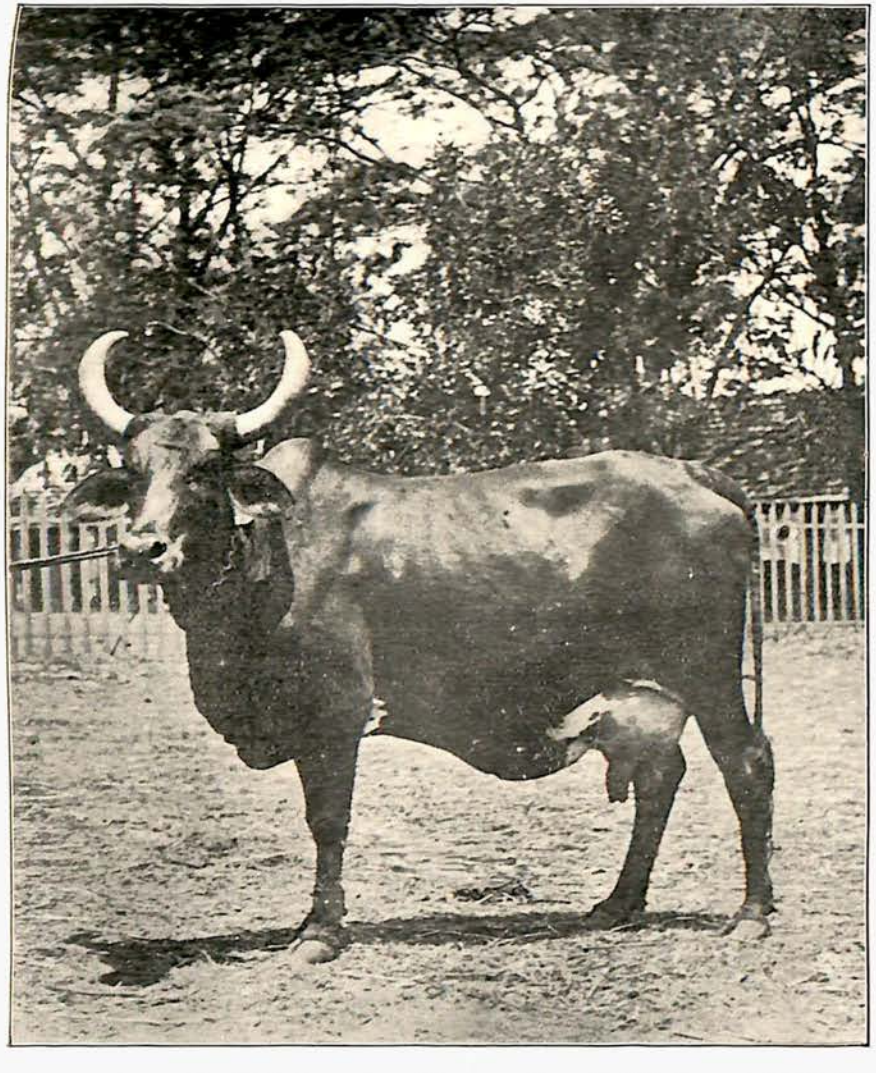
pleted a course of not less than two years' instruction at an institution recognized by the Imperial institute. There were 190 applications for admission to this course which is open to matriculates, but for want of accommodation 15 only were admitted. The ALLAHABAD AGRICULTURAL INSTITUTE of the American Presbyterian Mission is the only other institution recognized for training students for this diploma course.

Six **agricultural schools** with 152 students functioned during the year in BOMBAY. An important experiment in vernacular primary education of introducing an alternative course in the higher standards qualifying for the alternative Vernacular (Agricultural) Final Examination, was started in the year under report. Seventeen masters completed their training and took over their duties. The first batch of teachers does not, however, appear to have been adequately trained, and it is therefore proposed to put an able officer of the department on special duty to conduct this training personally.

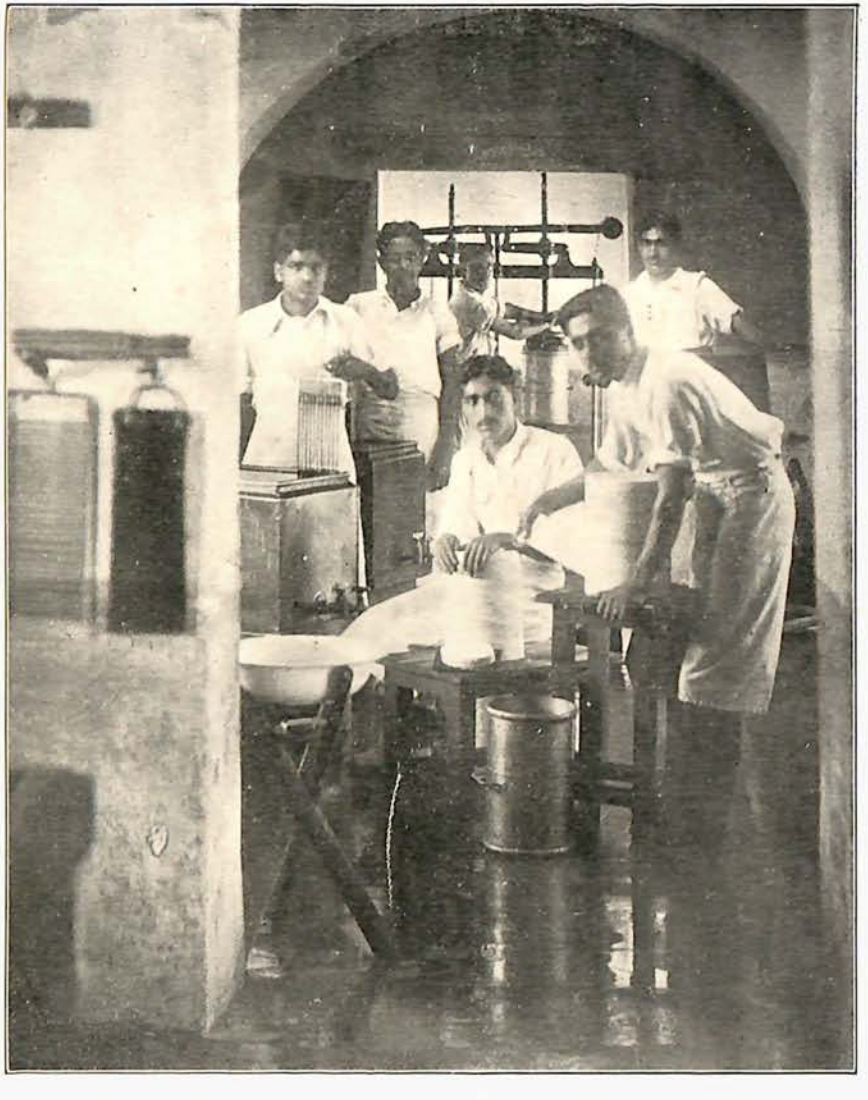
There are two agricultural middle schools with a course of instruction extending over two years in MADRAS; the school at Taliparamba has 31 students and the school at Anakapalli has 11 in residence. Both these schools have now worked for two years, and at the first examination held, all the 19 students who had completed the course received a certificate. It is too early to say whether a demand will arise for the type of education imparted.

Of the two agricultural schools in BENGAL, the one at Chinsura has been closed. Even at Dacca, a monthly stipend is not sufficient to attract the sons of cultivators when there is no Government employment in prospect; the school has only 14 students, whereas there is room for 30. The agricultural classes attached to the Amarpur and Durgapur secondary schools are, however, reported to be doing well.

There were 43 students in residence at the Bulandshahr agricultural school in the UNITED PROVINCES which gives a course of two years. The first batch of students who had completed the full course did well at the examination, only one out of 23 having failed to obtain the certificate. It is proposed to



Sindhi Cow No. 721, Bangalore Farm. Gave 7,175 lb. and 7,272 lb. of milk during last two lactations.



Diploma students making cheese at Imperial Institute of Animal Husbandry and Dairying, Bangalore.

PLATE IV.

utilize the school in future for training teachers for district board schools.

Both the agricultural schools started in the CENTRAL PROVINCES have so far failed to establish their utility. The one at Chandkhuri is to be closed after the present year. The Powarkhera school at Hoshangabad is to be allowed to continue as there are strong indications that it is increasing in popularity and meeting some at least of the educational needs of the rural community.

There are no special agricultural schools in the PUNJAB, but the ordinary vernacular middle schools are utilized for imparting a practical training in agriculture to school boys in rural areas. The special features of the scheme are that (*a*) a small farm for practical training is attached to each school, that (*b*) training in agriculture is given by a teacher specially selected for the work and trained for a year at the Agricultural College at Lyallpur. The scheme has achieved popularity and the number of middle schools teaching agriculture rose from 43 to 60 during the year under report.

The subsidized agricultural school at Pyinmana in BURMA, which is managed by the American Baptist Mission, has successfully completed the first year of its existence. When the school opened for the second year there were 22 old students and 35 new entrants.

All the three students in the final class of the Hebbal school in MYSORE obtained the diploma. Fifteen students at the Chiknahalli school qualified for a certificate at the end of the year.

On completion of the two years' course at the Alwaye agricultural school in TRAVANCORE, 26 out of 31 pupils obtained the certificate. It is proposed to start another school of this type at Kottarakarai.

Short courses. The six months' practical vernacular course at LYALLPUR was taken advantage of by 17 students, of whom 8 were employees of the Co-operative Department and nine were sons of zemindars. Nine senior vernacular teachers

took the one-year course qualifying for the teaching of agriculture in the rural middle schools of the Punjab. The rural economy class, which lasts for a month, was attended by 24 officers of other departments. The six months' vernacular course at Gurdaspur was taken by 19 students.

Thirty-seven elementary school teachers deputed from the East Coast districts of the MADRAS PRESIDENCY for training in practical agriculture were given a month's course at Anakapalli and Samalkota. It is doubtful if such a short training is worth the trouble taken. The classes for juvenile and adult labourers on the farms at Coimbatore, Palur and Anakapalli continued to function, and the results of the examinations were satisfactory.

In addition to the usual training given to overseers on the central farms in BIHAR, two men were given a short course in practical agriculture at Cuttack.

In BURMA, organized attempts were made to give short courses varying in length from a week to a month at various farms of the province. Altogether 94 adult farmers received practical training in improved methods of cultivation.

Short practical courses in the driving of tractors and the handling of tractor implements and oil engines were given at NAGPUR in the Central Provinces.

In ASSAM, nine apprentices were under training at different farms of the province for employment as demonstrators.

CHAPTER VII.

THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE.

The co-operative movement in India was started about 20 years ago. In the beginning pioneer workers in the field of co-operation were confronted with many difficulties arising out of the ignorance, indifference and conservatism of the people. These barriers to rapid progress are still being keenly felt. The true spirit of co-operation is not as yet widespread and is not therefore strong enough to carry the movement forward without a great deal of official help. Nevertheless real progress has been made, as will be apparent from the following figures culled from the provincial reports on the working of co-operative societies.

In the year under report there were 48,369 agricultural credit societies in India with a membership of 1,566,553 and a working capital of Rs. 14,93 lakhs. The real progress of co-operation cannot, however, be judged by figures alone. Suffice it to say that the movement is spreading and that its possibilities as a great economic and educative force in the land are being more widely recognized as years go by. The aim of the Co-operative Department resembles in many respects that of the Department of Agriculture; for the object they both have in view is to raise the economic standard of the people.

While the development of a sound system of rural credit is, and will always be, the main function of Co-operative Departments, more attention is now being given to the building up of non-credit societies, the duties of some of which are closely allied to the district extension work of Agricultural Departments. When the two departments co-operate in this work much greater progress is made than when they work independently. At the last meeting of the Board of Agriculture held in January 1924, the progress made in non-credit co-operation and ways and means of stimulating further progress were fully

discussed and stress laid on the paramount importance of co-operation between these two sister departments. It was felt that by working together they could do much to narrow the gulf between the theory and practice of agriculture, and to get cultivators in large numbers to incorporate into their farm practice agricultural improvements effected by Departments of Agriculture. The relations between the two departments are in most provinces becoming increasingly close, but are not yet as close as they ought to be.

The expansion of non-credit agricultural co-operation with which Departments of Agriculture are mainly concerned will, it is hoped, proceed *pari passu* with the expansion of credit societies; for a good credit society is the best training ground for the more elaborate forms of non-credit agricultural societies. Of societies of the latter type there were 1,625 working during the year. The progress made by many of them has not been entirely satisfactory. Cattle-breeding, cattle-insurance and dairy societies have mostly failed to make any headway, owing, in nearly every case, to the people concerned not taking a live interest in them. Where a society is successful, its success is too often dependent on the keenness, business ability and honesty of one or two members who take a personal interest in it.

The following facts and figures give some idea of the progress of the co-operative movement in the different provinces :—

Bombay. The improvement and consolidation of existing societies rather than their multiplication continued to be the policy of the department. Nevertheless, there was an all-round increase in the number of societies, membership, working capital and reserve fund. There are now 2,860 credit societies with a membership of 204,446 and a working capital of Rs. 186 lakhs. The number of non-credit societies increased from 159 to 190. Though there are very few purely seed societies in the Presidency, a large quantity of pure seed was distributed by societies which supply seed and sell and hire agricultural implements. The most important non-credit societies in the Presidency are sale societies, of which the most

advanced are those dealing in cotton. The societies dealing in grain at Shikarpur and Malir in Sind were much appreciated by the zemindars of the surrounding tract. The Haveli Sale Society in Poona sold *jaggery* worth Rs. 1,38,000, and some of the Provincial Banks did a big business in *gur*, manures and implements.

Madras. The total number of agricultural credit societies rose to 8,103, an increase of 1,003 over the figure of the preceding year. The working capital increased from Rs. 265 lakhs to Rs. 314 lakhs. Seventy-seven non-credit societies with a working capital of Rs. 4,24,012 were engaged in the sale or purchase and sale of agricultural requisites and products. Of these, 47 earned a profit while 30 incurred loss. The South Kanara Garden Planters' Co-operative Wholesale Society and the Nadavars' Co-operative Society did good work during the year. The former effected the joint sale of members' produce such as paddy, arecanuts, etc., to the value of Rs. 4,82,808. A campaign against the *mahali* disease was carried out successfully by co-operative societies in Malabar under the guidance of the Agricultural Department. Twenty-five societies under the Pattambi and Kumaranallur Unions jointly purchased 250 sprayers and sprayed about 1,230,000 arecanut trees.

Bengal. The number of agricultural credit societies in Bengal rose from 7,011 to 8,638, the membership from 186,944 to 216,190 and the working capital from Rs. 1,48,62,021 to Rs. 1,79,33,084. The Naogaon and Kazipur sale and supply societies did a big business in rice and jute respectively. The Naogaon *ganja* cultivators' co-operative society also did useful work. Irrigation societies have proved their usefulness in this Presidency. Of these there are new 173 working.

Punjab. The number of agricultural societies of different types increased from 8,853 to 9,791, the membership from 223,367 to 253,831, and the working capital from Rs. 2,63,81,826 to Rs. 2,93,82,591. During the year two land mortgage banks were opened. The Jhang bank had another successful year; it advanced Rs. 18,375 for the redemption of 255 acres of land and 394 date-palm trees and Rs. 19,200

for land improvement. At the end of the year under report there were 154 societies for the consolidation of holdings; about 11,352 acres were readjusted and the number of blocks reduced from 13,691 to 2,387. The number of societies for clearing silt from irrigation channels has risen to 23. Another useful type of society in this province is that for cattle-breeding, of which there are now 36 with 741 members owning about a thousand cows. Ten co-operative commission sale shops were at work during the year. Of these, the one at Okara sold produce worth Rs. 19¾ lakhs.

United Provinces. The total number of agricultural societies increased from 5,209 to 5,445, the membership rose to 130,949 and the working capital to Rs. 74,92,490. Non-credit agricultural societies in these provinces have not done well; the number has been reduced to 9.

Central Provinces. There was a further decline in the number of societies of all kinds. The number of agricultural credit societies declined from 4,416 to 4,263, the membership from 70,820 to 66,710 and the working capital from Rs. 1,27,62,195 to Rs. 1,21,13,318. The agricultural seed unions started in these provinces many years ago have continued to do good work. In the year under report they distributed 2,583 tons of *roseum* cotton seed and sold and hired out a large number of implements. One important feature of the year is the registration of two Divisional Co-operative Institutes, one for Berar and the other for the Jubbulpore and Nerbudda Divisions. The constitution of the Berar Institute is modelled on that of the Central Co-operative Institute, Bombay, and its membership is open both to societies and individuals.

Burma. The number of agricultural credit societies rose from 4,159 to 4,211, the membership from 97,948 to 98,167 and the working capital from Rs. 1,84,56,905 to Rs. 2,02,65,623. The purchase and purchase-and-sale societies as well as the production and sale societies with few exceptions worked at a loss.

Bihar and Orissa. The number of agricultural societies rose from 4,661 to 5,108, the membership from 134,821 to

145,102 and the working capital from Rs. 85,59,059 to Rs. 1,15,85,696. Some of the credit societies did useful work during the year in distributing improved varieties of paddy, sugarcane, potatoes and wheat. The nine agricultural purchase and sale societies sustained a loss on the year's work. Seventy-eight grain *golas* (stores), with a total membership of 21,636 and working capital of Rs. 64,401 in cash and 2,750 tons of grain, were at work during the year. They are reported to have proved eminently successful.

Assam. The number of agricultural societies rose from 583 to 642, the membership from 25,435 to 28,420 and the working capital from Rs. 800,750 to Rs. 977,578.

Co-operative Cotton Sale Societies.

During the year under report, the value of cotton sold by co-operative cotton sale societies, in the Bombay Presidency, amounted to Rs. 53½ lakhs as compared with Rs. 23·8 lakhs last year. The Hubli and Gadag societies, which are the oldest, continued to extend their operations. The former dealt with about 5,000 bales of cotton and carried on useful propaganda work, too, with a view to encouraging the cleaner picking of cotton. The Haveri and Bailhongal societies also did a big business. The Pachora sale society in Khandesh had a turnover of Rs. 9 lakhs and the societies in Gujarat did business to the extent of Rs. 6½ lakhs. The distinctive features of the sale societies in Gujarat are that they sell only members' cotton and that no one is admitted as a member who does not use the improved seed distributed by the societies.

Co-operative Milk Societies.

In the Bombay Presidency the progress of dairy societies has not been satisfactory. The best among them are those at Malvan and Belgaum which sold milk to the value of Rs. 13,000 and Rs. 14,000 respectively. In Bengal, there were 50 milk societies working in the Baraset Sub-division and 4 in the Jessore District during the year. All of them were members of the Co-operative Milk Union in Calcutta. The difficulty of

transporting milk from rural areas to Calcutta is still blocking the way to further progress. In the United Provinces, the Lucknow and Benares dairies are practically dead and the Allahabad dairy is losing ground. In the Central Provinces, the Amraoti co-operative dairy worked at a loss during the year. The co-operative dairy at Telinkheri near Nagpur again had a very successful year; it sold milk worth Rs. 36,584 and made a profit of Rs. 10,466. This co-operative concern which was started about 12 years ago is a model which is worthy of imitation. In Bihar and Orissa, the Mayaganj dairy society in Bhagalpur just paid its way.

Cattle Insurance.

Of the 29 cattle insurance societies in the Punjab 5 only did any work during the year. The cattle insurance society at Jarouli (Agra) in the United Provinces continued to work fairly well. The membership of cattle insurance societies in Burma declined during the year and the number of animals insured also decreased.

CHAPTER VIII.

LIVE STOCK.

I. Prevention and Treatment of Disease.

Details of the work done by the Civil Veterinary Departments during the year under review are given in tabular form on page 131 (Appendix VII). Twenty-six new hospitals and dispensaries were opened, bringing the total to 668. The number of cases treated and castrations performed at these institutions rose to 14,80,435 from 13,98,877 in the previous year. A similar increase in the number of animals treated by itinerant veterinary officers is to be recorded, the figures for the two years 1923-24 and 1922-23 being 8,93,474 and 8,58,950 respectively. The most satisfactory feature of the district work has been an appreciable increase in the number of animals offered for castration. This has been specially due to the use of the Burdizzo castrator in some provinces, by which an animal can be rendered sterile without cutting the skin or shedding blood, thus rendering the operation unobjectionable to the religious susceptibilities of the people. The total of 23,73,909 cases treated shows an increase of 35 per cent. over the figures for 1920-21, a definite testimony to the increasing confidence on the part of the Indian peasant in the work of the Civil Veterinary Department. As a further indication of the popularity of the medical treatment of live stock, it may be pointed out that in some provinces the people now come forward freely to contribute towards the building of veterinary hospitals. It is, however, a pity that many local boards, upon whose financial assistance the department is dependent for district work, are still unwilling or unable to pave the way for more rapid progress by employing the staff necessary to meet all calls made on the department for veterinary aid. In Bihar and Orissa, over 25 per cent. of known outbreaks remained neglected for want of men to attend to them. Even in the Punjab with the strongest veterinary cadre in India, there is only one Veterinary

Assistant for every 1,33,333 animals scattered over an area of about 555 square miles.

During the last five years there has been a steady reduction in the mortality reported as being due to contagious diseases, the figures being 3,37,396, 2,88,375, 2,37,332, 2,11,930 and 2,00,962 respectively. While much importance should not be attached to the accuracy of figures compiled through a not very reliable reporting agency, they do afford an indication of the relative intensity of contagious diseases from year to year. The most notable reduction has been in the ravages of rinderpest, the reported mortality from which during the year under review was 96,082 as against 2,52,200 in 1920-21. Bengal alone contributed one-fourth of the total, while provinces recording more than 10,000 deaths from the cattle plague were Burma, Bihar, Punjab and Assam.

Although the year was a comparatively healthy one for live stock and the number of outbreaks in which inoculation was undertaken was slightly smaller, there was an increase of 20 per cent. in the number of animals inoculated and vaccinated, the number having risen from 6,79,195 to 8,12,141. This not only redounds to the credit of the district staff, but is also another testimony to the fact that old prejudices against prophylactic treatment of animal diseases are being slowly overcome. Although prompt intimation of the occurrence of an outbreak is the *sine qua non* of effective control, village officials have not yet given up their dilatory methods of reporting.

II. Incidence of Disease.

Bombay. Although rinderpest was more prevalent than in the previous year, the total mortality of 11,457 from contagious diseases was higher than that of the previous year by 203 only. This was due to a substantial reduction in the number of deaths from hæmorrhagic septicæmia and blackquarter. Cases of surra were reported from the city of Bombay and seven districts, mainly of the Northern Division.

Madras. There was a further drop in the mortality from contagious diseases, the figures for the last three years being

34,258, 28,178 and 23,213 respectively. It is especially gratifying that the mortality from rinderpest, *viz.*, 3,434, was lower than it has been for many years.

Bengal. Rinderpest was prevalent more or less in all districts and was responsible for nearly 90 per cent. of the total mortality of 27,389 which exceeded the previous year's figure by 4,391.

Bihar and Orissa. There was a substantial reduction in the deaths from rinderpest and in the total mortality from 30,737 to 20,730. Foot-and-mouth disease was not only widespread but also unusually severe, and accounted for 480 deaths. A severe outbreak of surra appeared among cattle in the Dinapur Sub-division.

United Provinces. The incidence of both rinderpest and hæmorrhagic septicæmia was remarkably low this year, and the total mortality was reduced from 14,254 to 8,760. Surra also was less virulent.

Punjab. Rinderpest and hæmorrhagic septicæmia were more widely prevalent than in the previous year, and the total mortality rose from 28,907 to 39,402. Out of 233 deaths reported from surra, 73 were confirmed microscopically.

Burma. The reported number of deaths from contagious diseases fell from 27,188 to 20,141. Rinderpest was specially virulent in Upper Burma, and took a heavy toll of buffaloes.

Central Provinces. From the remarkably low figure of 7,391 for last year, the mortality from contagious diseases rose to 14,792. Hæmorrhagic septicæmia and blackquarter accounted for 4,152 and 5,004 deaths, respectively, as against 1,916 and 691 in the previous year. Rinderpest prevailed in a mild form and was responsible for 2,631 deaths only.

Assam. The total number of deaths from contagious diseases was practically the same as that of the preceding year, *viz.*, 25,530.

North-West Frontier Province. The mortality from contagious diseases rose from 476 to 1,183. The rise was mainly due to rinderpest and hæmorrhagic septicæmia. Eleven cases of surra were reported as against six last year.

Sind. There was a further fall in the mortality from rinderpest which stood at 2,944 as against 4,401 and 12,062 in the two preceding years. The total number of deaths from all causes was 4,881 as against 5,486 in 1922-23.

Baluchistan. The number of deaths from contagious diseases rose from 1,125 to 3,450 due mainly to the wider prevalence of anthrax.

Rajputana. There was a further decrease in the reported mortality which fell from 99 to 34, of which 23 were due to foot-and-mouth disease.

III. Preventive Inoculation.

A natural decline in the prevalence and intensity of outbreaks of rinderpest throughout India, the prevailing financial stringency which greatly restricted the purchasing resources of local authorities, the transfer of the control of veterinary dispensaries in some provinces to municipal bodies, and the imposition in Madras of a small charge upon animal owners for all cattle protected with serum in the scene of an outbreak of rinderpest, combined to reduce the demand for the products of the Imperial Bacteriological Laboratory at Muktesar which amounted to 2,549,515 doses in 1922-23 and 2,513,207 doses in 1923-24, as against 3,348,535 doses in 1921-22. The following table compares the doses issued during 1923-24 with the average for the previous five years.

	1923-24	Average of previous five years
Rinderpest serum	1,986,399	2,813,527
Anthrax do.	29,834	30,179
Hæmorrhagic septicæmia serum . . .	221,174	152,524
Do. vaccine	177,600	150,041
Blackquarter do.	40,600	32,125
Mallein	29,162	94,675

Although a reduction in demand owing to the decline in the incidence of disease may be regarded as a salutary phenomenon from the national standpoint, the laboratory must always be ready to cope with larger demands, if and when made. This obligation has been kept in view in developing the manufacturing resources of the branch laboratory at Bareilly. It has been found economical to manufacture anti-rinderpest serum at Bareilly, and to send it to Muktesar for storage. A good serum stored at Muktesar remains potent for about two years, but for want of adequate storage facilities, it rapidly deteriorates in the plains. Authorities indenting for it have, therefore, been advised to avoid getting an unnecessarily large stock of it.

Rinderpest levies every year a heavier toll on Indian cattle than any other single disease in a decade, and the inoculation operations are mainly directed towards the control of this scourge. Anti-rinderpest serum confers immunity upon an animal exposed to infection, for a period sufficiently long to carry it through an outbreak. That it does so, will be manifest from the fact that while the normal mortality from rinderpest is about 75 per cent., amongst the 4,13,147 bovines inoculated during the year the death rate was only 0·56 per cent. The immunity conferred, however, is not as strong as that which an animal acquires by recovery from the disease. It is therefore desirable that animals that have received a serum inoculation should be allowed to mix with those that are showing signs of the disease, so that they may contract the infection and acquire a stronger immunity. This very desirable eventuality is, however, difficult to attain. Hence a method has been devised which aims at imitating this method of immunizing cattle against the ravages of this disease. They are inoculated simultaneously with an adequate dose of protective serum and a very small quantity of blood withdrawn from an animal at the height of the disease, with the result that the attack, though barely noticeable, makes the animal immune for life. At the present time this method has been adopted on a small scale only; but the results achieved are so satisfactory that in course of time it is hoped that it will become more generally adopted.

Hæmorrhagic septicæmia comes next in importance to rinderpest. It is prevalent particularly during the monsoon months, and differs from rinderpest in that it does not spread rapidly; but cases of disease affecting one or several animals may occur frequently, at short intervals, for a more or less prolonged period. By hyperimmunizing cattle with cultures of the causative baccilus, a potent serum is produced which saved during the year under report 99·95 per cent. of the 1,71,366 bovines inoculated. The immunity conferred is, however, again a short-lived one. A more lasting immunity is set up by inoculating cattle with cultures of the causal germ which have been killed by heat before they are issued, so as to render them innocuous. Animals in low-lying villages of the Punjab, liable to visitations of this disease, are now regularly inoculated every year with the dead cultures or vaccines as they are called. Of the 1,44,939 animals thus protected during the year, only one was reported to have died.

Anthrax and blackquarter are the other contagious diseases against which prophylactic measures are taken on a large scale. Results of inoculations made during the year show that the mortality among treated animals is as low as 0·32 and 0·15 respectively. Hitherto animals used to be protected from blackquarter by a vaccine injected at least a month before the annual outbreak; but when the disease actually broke out no remedy was in hand. This difficulty has been surmounted during the year under review by the manufacture of an anti-serum at Muktesar which can safely be used during an outbreak.

The control of contagious diseases is, however, difficult to establish without compulsory inoculation, isolation and disinfection. The Second Veterinary Conference held at Calcutta, therefore, recommended the introduction of central legislation in the form of a Diseases of Animals Act which would give permissive powers to Local Governments to frame regulations for the control of certain scheduled diseases.

IV. Veterinary Education.

For the training of students in veterinary science, there are colleges at Bombay, Madras, Calcutta and Lahore, and schools

at Insein and Taunggyi in Burma. The colleges at Bombay, Madras and Calcutta continued to give a 3-year diploma course in English, while that at Lahore gave a 4-year course in English in addition to the remaining part of the old 3-year vernacular course which it has replaced. The number of students who passed the final examinations of the colleges dropped from 112 in 1922-23 to 82 in the year under report. Some of the reasons that have brought about the decrease are the inadequacy of the pay of Veterinary Assistants, the reduction in the number of appointments and the discontinuance by the Military Department of the practice of sending students to the Lahore college.

The veterinary schools at Insein and Taunggyi in Burma continued to impart instruction in the vernacular in a 3-year and a 1½-year course respectively. Fourteen students passed the final examination at Insein as against 10 in the preceding year. A scheme for the better equipment of this school has been partly adopted by the Government.

The first batch of six officers of the Provincial Service selected for a post-graduate course of two years qualifying for appointment to the Imperial cadre completed their training at the Muktesar Laboratory during the year under review. Systematic courses of training in laboratory methods extending over four or five months have also been instituted at this Laboratory for members of the Indian Veterinary Service and the Royal Army Veterinary Corps, and five officers availed themselves of the facilities afforded during the year. An Assistant Professor also took a short course in veterinary pathology.

Fifteen farriers were trained at Lahore, while at Calcutta 30 students under training as Sanitary Inspectors were given a course of lectures on infectious diseases of animals. Seven students passed out during the year from the veterinary compounders' class attached to the Nagpur hospital.

The United Provinces Veterinary Medical Society started in 1912 continues to do good work. It is publishing an Urdu Veterinary Journal.

V. Veterinary Research.

The Imperial Bacteriological Laboratory at Muktesar had, during the period under review, a full complement of qualified officers, and the facilities for research afforded by the institution were utilized to a larger extent than ever before. All the more important diseases of bovines and equines are being investigated by the intensive application of modern methods of research, and further light has been thrown on many problems of great importance.

Rinderpest. In view of the importance of rinderpest in the live stock economy of India, etiological and immunity researches on this disease engaged the best attention of the staff. The factors which make for the survival in virulence of the causal agency of the disease are under investigation, and an endeavour is also being made to view its characteristics from a different angle, as it were, by implanting it upon a different species of host. Tests made with *Stegomyia albopicta* as a possible transmitter of rinderpest have given negative results, indicating that the virus soon becomes inert in the body of the mosquito.

Researches into the perfecting and cheapening of the process of serum manufacture gave important results during the year. The knowledge now available indicates that steps should be taken to abandon completely the process of so-called hyper-immunization for the production of an anti-rinderpest serum. A plentiful supply can be obtained, from suitable serum producers, of good potency for a sufficiently long period of time after " setting " the initial rinderpest reaction to the desired degree of intensity; for economical, utilitarian and humane reasons, the adoption of a routine procedure based upon these principles seems justified.

Haemorrhagic septicaemia. Researches upon this disease are being directed with the object of ascertaining more information regarding the properties of the virus and evolving better methods of securing products for combating the disease.

Contagious bovine abortion is the subject of another investigation at Muktesar. It has been ascertained that buffaloes

possess a high degree of resistance, and indigenous cattle are less susceptible to clinical abortion than are cattle with a considerable admixture of European blood. Work is in progress upon the possibilities represented by differences in virulence of strains of the causal organism isolated at the laboratory.

Strangles. The efficacy of vaccination against this disease is being investigated by the inoculation of dead streptococci derived from a considerable number of samples of pus obtained from natural cases of infection. The results so far obtained indicate that prophylactic vaccination exerts an appreciable effect in depressing the incidence of morbidity and mortality from strangles, and that continued treatment with the " extracted " form of vaccine yields superior results to those obtained with a vaccine made in the ordinary way from streptococci.

Surra. The experiments on this disease at Muktesar are designed to discover an effective, cheap and easily applicable system of treatment for adoption in the field. The results with tryparsamide were very disappointing, but an adequate dose of tartar emetic, or of an insoluble bismuth salt (bismuth phosphate suspended in a mucilage of gum acacia) produced a rapid clinical cure in cattle which have relatively high natural resistance. The prospects of curing the very susceptible species of hosts such as horses, however, do not seem to be very hopeful.

Mange. A systematic study of both the sarcoptic and psoroptic forms of this parasite which infests buffaloes at Muktesar has shown that the action of 10 per cent. creosote in olive oil is fatal in 20 minutes at 31° C. for all males, nymphs, larvæ and the majority of pubescent and ovigerous females.

Bovine tuberculosis. An investigation has been started in co-operation with the Research Fund Association to ascertain whether the rare incidence of bovine tuberculosis in this country is due to the relatively high resistance of the indigenous breeds of cattle, or to the low virulence of the infective organisms, or merely to the natural limitations towards the spread of the disease which result from the conditions under which cattle are reared in this country. While buffaloes are found to be much

more resistant than cow calves, the latter exhibit nearly as high a degree of susceptibility as is possessed by the average British calf.

Infectious bovine nasal granuloma, bovine coccidiosis and piroplasmosis are some of the other diseases under study at Muktesar. In the Central Provinces, tests carried out on a large scale indicate that injection of *trypan blau* is an effective remedy against piroplasmosis, a form of malaria in animals which, though not fatal in the ordinary sense, usually becomes chronic and thus predisposes the subject to succumb easily to any other infection.

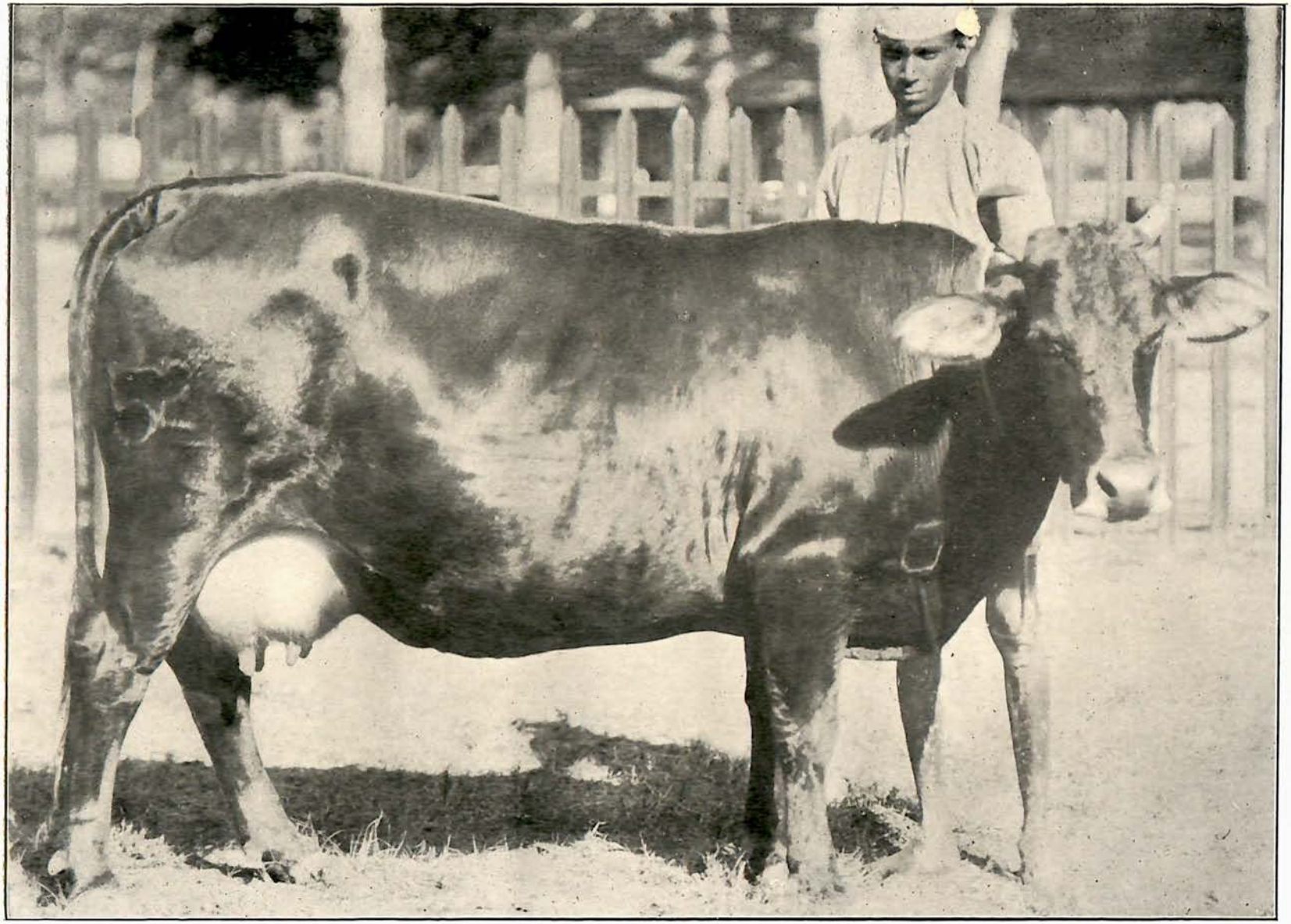
VI. Breeding.

Cattle-breeding. Among the essential factors required for the development of Indian agriculture, the improvement of the cattle is perhaps the most important as the bullock is still the principal motive power in the fields and will continue to be so for generations to come. Large expanses of culturable waste which once supported breeding herds of cattle are now producing agricultural crops, and are no longer available for grazing. If cattle are to be profitably reared in arable areas, the husbandman must have a cow which will give sufficient milk and *ghi*, and at the same time rear a good draught bullock. The combination of the two qualities of milk and draught is found to a certain extent in such breeds as the Sahiwal, the Sindhi, the Gir and the Thar-Parkar. It has been demonstrated by work already done at various centres in India that it is possible to evolve such a combination by breeding on scientific lines. The cattle-breeding programmes of Agricultural Departments, therefore, aim at evolving dual purpose animals by grading up existing breeds by selection, crossing and better feeding. The Cattle Conference, which met at Bangalore during the year under review, generally approved of the lines on which this policy is being pursued in the different provinces. The question of introducing crops in the rotation, which will provide wholesome fodder for cattle, is also receiving attention. Luscious fodders unknown in India 20 years ago have been introduced, methods of storing green fodders in silos have been devised, and accurate information

PLATE V.

IN THE HOME PADDOCKS.

The milking herd of the Imperial Institute of Animal Husbandry and Dairying, Bangalore.



Half-bred Ayrshire-Sahiwal Cow No. 523 at Bangalore Farm. Gave 11,941 lb. and 12,124 lb. respectively in two lactation periods.

PLATE VI.

regarding the digestibility and nutritive values of different foodstuffs and fodders is being collected. Facilities for a thorough training in modern principles and methods of animal husbandry and dairying have also been provided, by the opening of the Imperial Institute of Animal Husbandry and Dairying at Bangalore.

As explained in previous reviews, cattle-breeding operations at Pusa have been directed along two lines: (1) a herd of Sahiwals is being graded up by selective breeding, and (2) cows of the same herd are being crossed with imported bulls of high milking pedigree with the primary object of obtaining reliable information regarding the inheritance of observable characters in the crosses. Both the pure Montgomery and the cross-bred Ayrshire-Montgomery sections of the cattle herd are to an increasing extent justifying the lines of work hitherto pursued. The present milk yield of the graded-up Montgomery herd is almost double that of the herd as it was ten years ago; while it has been definitely established that though all crosses further from the first cross appear to vary considerably both in appearance and milking qualities, the cross-breds as a whole are much superior as milk producers to the best of the indigenous breeds. Work done at Pusa has proved the prepotency of the sire in milk production, and the advantage of shortening the dry period through weaning the calf from the time of its birth. The prepotency of the sire has practically reduced the problem of grading up milch breeds to one of using pedigreed bulls.

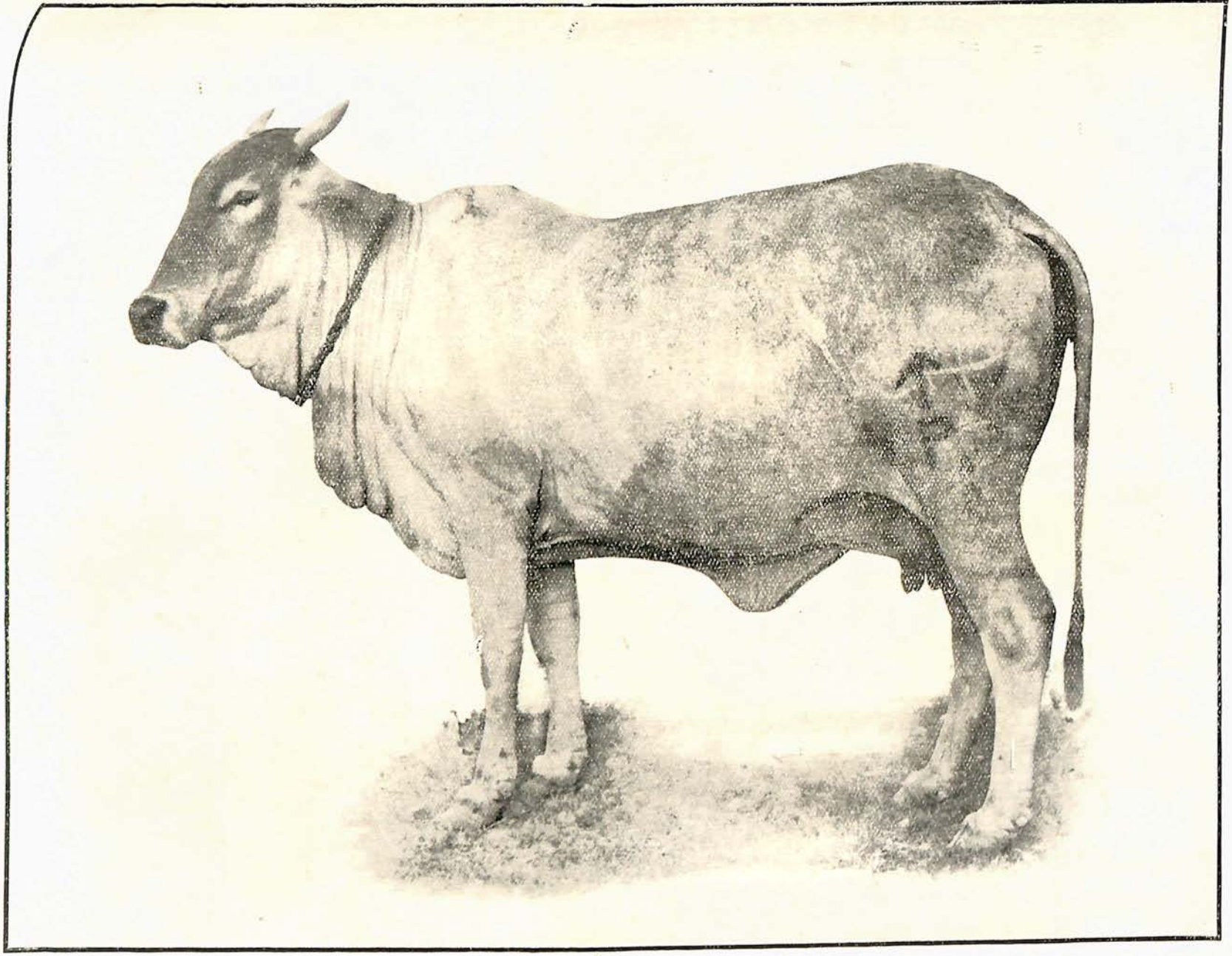
The transfer of the Bangalore, Wellington and Karnal military farms to the Imperial Department of Agriculture has been the means of increasing considerably the scope for work, as well as the usefulness of the Animal Husbandry and Dairy Section of the Imperial Department. On these farms, the best indigenous milch breeds are being improved by better feeding and selective breeding, as well as by crossing indigenous breeds with two of the most famous milch breeds of the West, *viz.*, the Ayrshire and Holstein.

With a view to demonstrating the possibilities of sterilising and transporting milk from rural areas where it is relatively cheap, to urban centres where it is dear, an up-to-date

sterilising plant was set upon the Karnal farm, and sterilised milk is now being sent from there to Calcutta—a distance of over 1,000 miles. Should this experiment prove a success, it will open up a vista of great possibilities for the dairy industry in India; for milk costs about three times as much in our towns as it does in many of our rural areas.

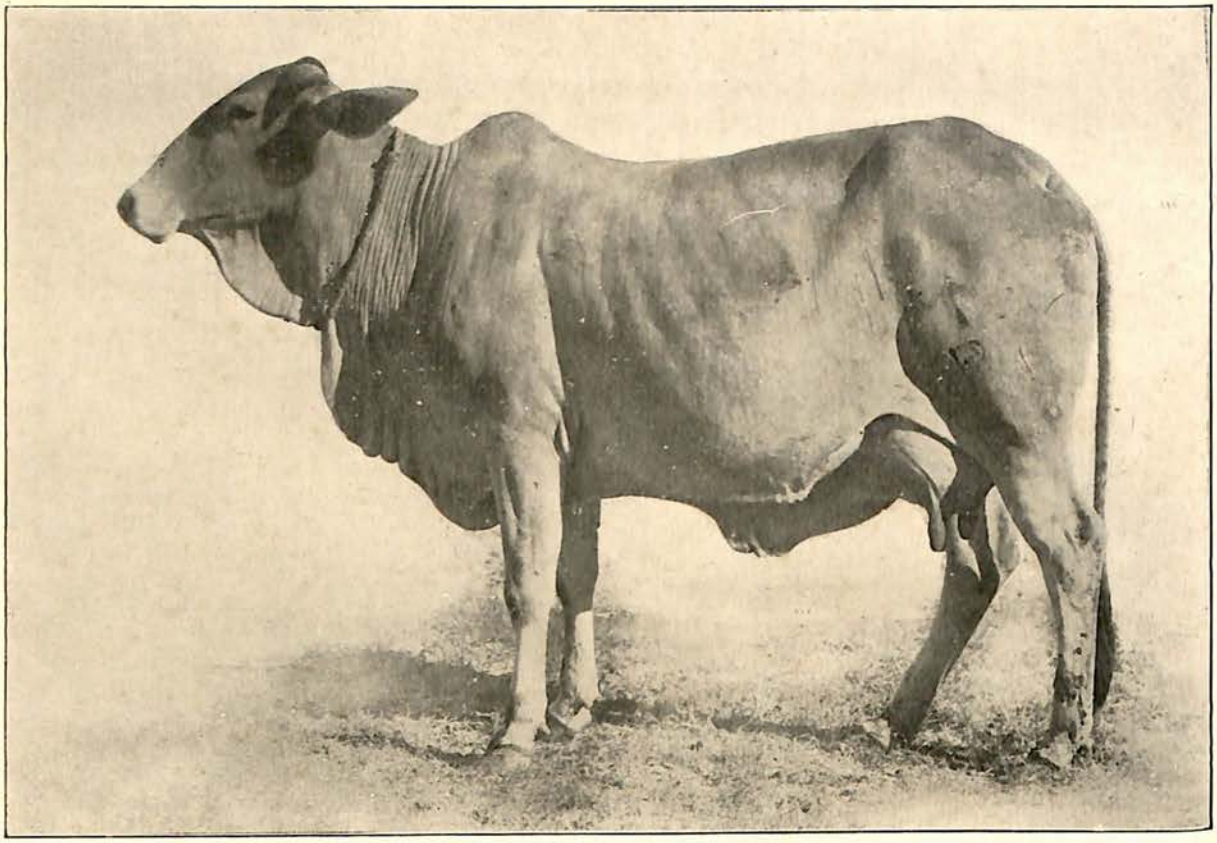
In the PUNJAB, cattle-breeding operations continue to be in charge of the Veterinary Department whose definite policy is to preserve and improve the local breeds by a process of selection from among the best specimens available. By the very thorough application of this principle the famous Hissar breed has been established, the progeny of which are very popular throughout the canal-irrigated tracts of the province. During the year under review, 226 bulls were purchased from the farm by the District Boards for stud purposes. With a view to meeting the growing demand for bulls of this breed, three additional farms have been started in the Lower Bari Doab Colony by private cattle owners who have been given grants of Government land. As regards pedigree Hissar stock, there are now about 1,400 cows in regular breeding on the Hissar farm, and over 1,700 pedigreed Hissar bulls at work in the province. The grading up of the Dhanni and Montgomery breeds has also been taken in hand. In the Dhanni tract, which comprises the districts of Attock, Jhelum and Rawalpindi, owners of approved bulls are subsidized on condition that the services of their bulls are made available for the villagers' cattle. There were 91 such bulls on the roll at the end of last year, and 7,157 cows were served by them. A similar scheme for the Hariana tract has been handicapped for want of funds, but through the enthusiasm of the District Boards of Rohtak and Gurgaon a satisfactory beginning has been made and 110 bulls have already been distributed.

The three cattle-breeding and the two dairy farms given on lease by Government for the preservation and improvement of the Montgomery breed are full of promise; the young stock on these farms already number 1,000 approximately. Small parcels of land have also been granted to the Junglis

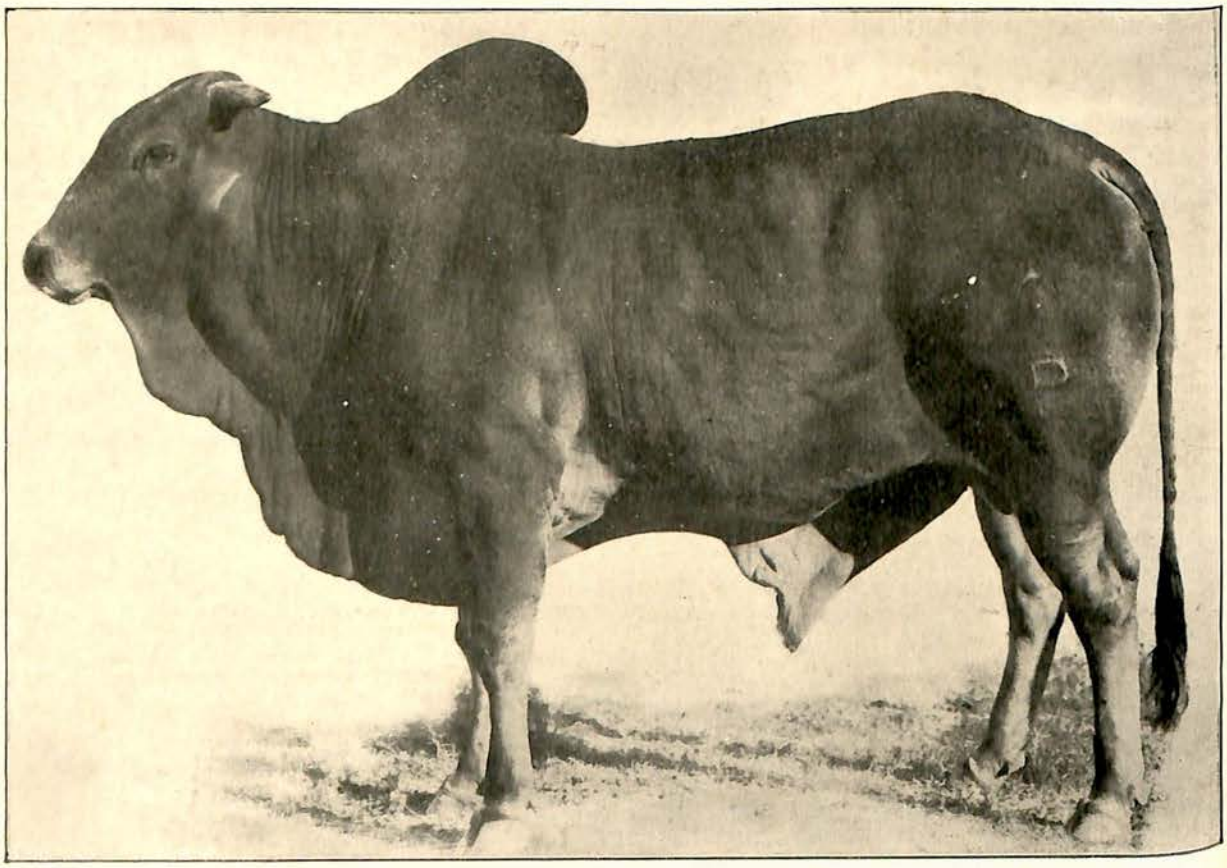


Sahiwal Cow Kamli No. 312 of the Pusa Herd. Gave 6,817 lb. of milk during best lactation period of 306 days.

PLATE VII.



Sahiwal Cow Sita No. 330 of the Pusa Herd. Gave 4,931 lb. of milk during best lactation period of 10 months.



Pure Sahiwal Bull Robert No. 227 of the Pusa Herd.

and Sayads of the original home of the Sahiwal breed on condition that they maintain two approved cows per square of 25 acres. Many of the cows collected by these men are unusually good specimens of the Sahiwal breed. Authentic milk records are being maintained at all these farms, and it is proposed to introduce the system at Hissar too, where hitherto cows have not been milked regularly.

In the NORTH-WEST FRONTIER PROVINCE, 45 bulls belonging to local bodies were at stud during the year.

There are two cattle-breeding farms in the UNITED PROVINCES; the breeds under improvement are the Hissar imported from the Punjab, and the local Mewati. Both are essentially draught breeds, but preliminary work is being undertaken with a view to evolving from them, by selection, a dual purpose type. An experiment is also being made in the direction of acclimatizing the Sahiwal breed in the Terai districts. The resources of the two farms are not sufficient to meet the demand for bulls, and numbers of yearlings are brought from outside and reared for sale. Out of 150 requisitions for bulls received during the year, 78 had to be refused; 302 selected bulls, raised on Government cattle farms, are now at stud in the province.

The only cattle farm in BENGAL is at Rangpur where both *desi* and imported Hansi bulls are used for mating with indigenous cows. During the year under review, one Thar-Parkar bull and five cows of the same breed have been added to the herd. From now onwards 12—20 young pedigree bulls of good stature, and carrying a milking strain, will be available for putting to stud in the districts. A small herd of Sindhi cattle is also being acclimatized at Dacca.

The Government of BIHAR AND ORISSA has adopted the policy of breeding cattle primarily for milk with a view to making the production of bullocks on arable holdings profitable. Herds of milch cows of mixed breeds have been started on farms where a demand for milk gives an opportunity of maintaining them economically. These cows are mated with bulls of the Sahiwal breed.

The attempt to grade up a herd of pure Patna cows, by eliminating inferior animals, is now producing definite results at the Upper Shillong farm in ASSAM. Within the last five years the daily yield per cow has risen from 3½ to 6 lb. As a preliminary step to an expert enquiry into the measures necessary to improve the breeds of cattle in the province, an officer has been deputed to carry out a cattle survey and to collect other necessary materials.

The whole cattle-breeding policy in BURMA has undergone a thorough revision, and it has been decided to discontinue the system of installing a bull and six cows at each of the central farms, and to open instead two stock-breeding farms, one for the building up of a herd of pure Burmese cattle and another for experiments in crossing the local animals with outside breeds.

In the CENTRAL PROVINCES, there are nine cattle-breeding and two dairy farms. The former were originally intended to form centres of supply from which pure bred bulls could be obtained, each herd being representative of the breed most favoured in the tract in which the farm was situated; while on the latter the local Gaolao cows were crossed with Ayrshire and Sahiwal bulls. The Sahiwal-Gaolao cross has been found such an improvement on the local breeds both as regards milk and draught, that it has been decided to grade up all the herds by the use of pedigree Sahiwal bulls as soon as these become available. On one farm, however, a pure Malvi herd is being maintained and on another a pure Gaolao herd with the object of supplying pure bred bulls of these breeds which are greatly in demand for draught purposes. Three hundred and fourteen animals, including 46 bulls, were issued from these farms during the year under review.

The BOMBAY Presidency, like the Punjab, is rich in its live stock, and the energies of the department are directed towards the preservation and improvement of the existing breeds, *viz.*, the Kankrej at Chharodi and Surat, the Amrit Mahal at Bankapur, and the Sindhi and Thar-Parkar at Karachi. In each case the object is to build up a first class herd of pure bred cattle with a view to supplying pedigree bulls for distribution.

Until funds are found for establishing similar farms for other breeds, an effort is being made to exploit a few of the best *gaoshalas* for this purpose. The conditions are that a certain number of approved cows shall be set aside and mated with a premium bull supplied by Government, and that a competent manager shall be maintained. Arrangements on these lines have been made at two centres in the Thana District.

In MADRAS, the main lines of work aim at the production of a number of good types of Ongole, Kangayam and cross-bred bulls. At Chintaladevi, pure herds of the two local breeds are maintained, while at Coimbatore, bulls of such milking strains as Sindhi, Sahiwal, and Ayrshire are used on different types of cows. Since the introduction of cross-breds on the college dairy herd in 1921, the average yield per cow per day has increased from 8·2 lb. to 14·7 lb. A buffalo-breeding station has been opened during the year at Guntur.

Three Holstein bulls are in service at the Rayenkere dairy farm in MYSORE, the local Hallikar and Sindhi cows being used as the foundation stock. The herds of Amrit Mahal cattle numbering 9,000 head, which have hitherto been used solely for the supply of transport bullocks, have, in the year under report, been transferred to the control of the Agricultural Department.

Two cattle-breeding farms are maintained in the TRAVANCORE STATE, and 34 calves of the Sindhi breed were sold during the year. Grants were made to 18 private persons for maintaining stud bulls for the benefit of the public.

The milch stock of the cattle farm started at BARODA to build up pedigree herds of Gir cows and Jafferabadi buffaloes comprises 40 cows and 30 buffaloes.

Sheep-breeding. The grading up of the *desi* sheep, with a view to producing an animal which will give good wool and mutton, though beset with many well recognized difficulties, is quite a feasible proposition. Climate and disease are the two factors which militate against the success of cross-breeding operations; but the results hitherto achieved in some provinces are by no means discouraging.

On the Hissar farm in the PUNJAB, local sheep are crossed with Merino rams imported from Australia, and the resulting progeny show improvement both in wool and carcase. During the year under review, 64 cross-bred rams and 82 ewes were sold to private individuals for breeding purposes, as compared with 47 rams and 121 ewes in the preceding year.

Merino rams are much appreciated by the flock-owners in the NORTH-WEST FRONTIER PROVINCE; but the spread of this strain has been handicapped by the district boards failing to meet the demand.

Cross-bred sheep in MYSORE continue to produce almost three times as much wool as the selected local sheep, and the quality, too, is a great improvement on *desi* wool. The number of rams distributed in the districts was eleven.

CHAPTER IX.

PUBLICATIONS OF THE AGRICULTURAL DEPARTMENTS.

The scope for publicity through the printed word is naturally limited in a country where the ryots are mostly illiterate, but it forms a useful adjunct to the schemes of propaganda for bringing agricultural improvements to the notice of those for whose benefit they have been devised. In fact the publications issued constitute an attempt to improve agricultural practices by working from the top downward, in that the information culled from them by the educated landlord may filter down to the actual tiller of the soil. A complete list of agricultural publications issued during the year under review is given in Appendix X (page 134). Briefly summarized, those issued by the Imperial and Provincial Departments of Agriculture are as follows :—

Imperial. Seven memoirs, ten bulletins and seven other publications were issued during the year, while over 18 publications were in the press on 30th June, 1924.

Among the more important publications issued during the year were the Proceedings of four conferences, *viz.*, the Thirteenth Meeting of the Board of Agriculture in India and the Cattle Conference held at Bangalore in January 1924, the Fifth Entomological Meeting held at Pusa in February 1923, and the Second Conference of Veterinary Officers which met at Calcutta in February 1923.

The Agricultural Journal of India, which is issued every two months, continues to maintain its popularity among the class of readers for which it is intended.

Provincial. In BOMBAY, in addition to the regular publication of " The Poona Agricultural College Magazine " and the vernacular journals of the agricultural associations three bulletins and six leaflets with their vernacular versions were issued.

The MADRAS Agricultural Department prepares a monthly

134283

digest of the operations of the department in English and the three principal vernaculars of the Presidency for circulation among agriculturists through the Revenue and Co-operative Departments' agencies as well as through important newspapers. The other popular medium for bringing the work of the department to the notice of the cultivator is the Villager's Calendar, of which about 75,000 copies were printed in five languages. Of the 12 leaflets issued during the year, the most important was that pertaining to the application of the Pest Act to cotton, which had a circulation of over 25,000 copies. The number of bulletins published was two.

The quarterly journal of the BENGAL department is published both in English and Bengali. Several leaflets were also issued, those dealing with the eradication of water hyacinth, cattle improvement and the growing of fodder crops being of special importance.

The UNITED PROVINCES have now a quarterly journal of its own in " The Old Boys' Magazine of the Cawnpore College." The departmental publications included notes on a cheap method of preparing silage and Upper Indian hedges.

In order to meet the frequently expressed desire of the public for a periodical which would convey to them in a simple form useful information and advice on agricultural matters, the PUNJAB department has started a journal called " Seasonal Notes " which is to appear half-yearly in English, Urdu and Gurumukhi. The occasional publications included leaflets on Coimbatore cane seedlings, *gur*-boiling furnaces, Punjab-American cotton, the cleaner picking and marketing of cotton and groundnut cultivation.

The publication of short monthly notes on " What to see at the farms " has been discontinued in BURMA, as they have been found not to serve any useful purpose. The old leaflets have been revised or re-written as required, and with the addition of some new ones the department has now 42 leaflets dealing with almost all practical aspects of agriculture in the province. Of the three bulletins issued, one on silkworm rearing was printed in the local vernaculars. The Agricultural Calendar was

published in Burmese as usual, and about 8,000 copies were distributed.

In ASSAM, one leaflet in English and two in Assamese were brought out.

CHAPTER X.

RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL DEPARTMENTS.

The total expenditure incurred by the Imperial Department of Agriculture during the financial year ending 31st March, 1924, was Rs. 8,32,129 as against Rs. 9,28,841 during the previous year. The gross receipts of the Agricultural Research Institute, Pusa, from sale of publications, farm produce, milk and other articles, amounted to Rs. 36,421 as against Rs. 45,852 last year. The details of expenditure are given below :—

	Rs.
General expenditure of the Pusa Institute (including the office of the Agricultural Adviser and Director)	2,72,420
Botanical Section	65,959
Chemical Section	62,423
Bacteriological Section	58,956
Mycological Section	58,227
Entomological Section	74,104
Agricultural Section	1,14,468
Sugar Bureau	38,023
Imperial Dairy Expert	46,381
Physiological Chemist	41,168
TOTAL	8,32,129

The receipts and expenditure of the three military dairy farms, taken over by the department on 1st July, 1923, were Rs. 2,63,122 and Rs. 3,47,583, respectively, for the nine months of working as detailed below :—

Name of Farm	Receipts	Expenditure
	Rs.	Rs.
Bangalore	1,17,599	1,67,934
Wellington	70,312	74,689
Karnal	75,211	1,04,960
TOTAL	2,63,122	3,47,583 (includes capital expenditure of Rs. 1,52,015)

The following tabular statement shows the receipts and expenditure of the Provincial Departments of Agriculture for the year 1923-24. The expenditure for the previous year amounted to Rs. 93,95,629.

Name of Province	Receipts	Expenditure	Remarks
	Rs.	Rs.	
Bengal	1,58,001	8,52,096	
Bihar and Orissa . .	51,305	3,31,210	From 1st July, 1923, to 31st March, 1924.
United Provinces . .	3,79,976	17,33,177	
Punjab	3,92,800	13,25,380	
Bombay	3,39,000	15,12,253	
Madras	3,54,655	14,47,949	
Central Provinces . .	2,74,996	9,56,641	
Burma	59,754	7,82,224	
Assam	58,292	2,56,136	
North-West Frontier Province.	15,610	53,606	
Baluchistan . . .	13,007	12,170	
Total .	20,97,396	92,62,842	

The net expenditure of Provincial Agricultural Departments was only a little over Rs. 70 lakhs. This indicates that the claims of science to the greater support of the country, and the function of science in economic development are not as yet fully realized in India.

APPENDIX I.

Areas under new and improved varieties of crops during the year 1923-24.

Name of Province	Name of crop	Advantages	AREA IN ACRES						Remarks
			1922-23			1923-24			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Bengal	Paddy (Kataktara, Indrasail and Nagra).	Heavy yield	26,615	140,372	166,987	20,030	156,255	176,285	
	Jute (Green *olitorius*, Kakya Bombai, R. 85 and R. 86).	Give finer quality and greater quantity of fibre.	71,470	157,343	228,813	35,825	173,608	209,433	
	Sugarcane (Tanna)	Yields greater quantity of *gur*	421	9,387	9,808	5,400	14,600	20,000	
	Groundnut	Yields handsome profit	131	402	533	150	475	625	
	Wheat (Pusa 12)	Has good milling qualities	37	180	217	41	200	241	
	Potato (Darjeeling, Naini Tal and Shillong).	Better yield	53	8,446	8,499	62	8,851	8,913	
Bihar and Orissa	Paddy (Dahia, Types I, II & III and C. P. Loochai).	Earliness and heavy yielders	1,270	4,580	5,850	1,110	10,485	11,595	
	Sugarcane (Coimbatore, Mungo and Java 213.)	Greater outturn in actual cane and sugar per acre.	171	2,110	2,281	425	2,304	2,729	In addition, 1,750 acres are reported under Coimbatore canes by the Sugar Bureau.
	Groundnut (No. 17)	Profitable crop even on poor lands	..	122	122	40	530	570	
	Soybean, Black mottled, Java.	An early fodder crop	..	..	..	5	10	15	
	Wheat (Pusa 12)	Prolific yielder	..	..	..	..	..	238	
	Dhaincha	Economical green manure for paddy lands	100	2,000	2,100	..	2,500	2,500	

Areas under new and improved varieties of crops during the year 1923-24—contd.

Name of Province	Name of crop	Advantages	Area in acres						Remarks
			1922-23			1923-24			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
United Provinces	Wheat (Pusa 4, 12, Cawnpore 13, Muzaffarnagar).	High yielding, rust resisting	139,546	132,800	272,346	35,491	81,135	116,626	
	Cotton (Cawnpore-American, J. N. 1, Aligarh white-flowered and K. 22).	Superior to *desi* cotton, better lint and higher ginning percentage.	75,120	50,000	125,120	10,206	21,230	31,436	
	Sugarcane (S. 39, 42 and 48 and Mauritius).	Gives more outturn of cane per acre and 50 per cent. of *gur* more than the local canes.	6,330	..	6,330	1,486	9,587	11,073	
	Barley	Better yielder than local varieties	15,000	8,200	23,200	10,966	..	10,966	
	Gram	Produce and quality better than local varieties.	14,070	16,955	31,025	19,461	4,166	23,627	
	Miscellaneous	Better yielders than local varieties	26,851	12,045	38,896	30,261	8,043	38,304	
Punjab	Wheat (Punjab 11, 17, 8a, Pusa 4 & 12).	More yield, fetch better price, possess good milling and baking qualities, ripen early.	86,233	827,276	913,509	49,358	956,407	1,005,765	
	Cotton—								
	American 4 F	Long-stapled variety which yields more than *desi* cottons. Fetches a premium of Rs. 3—6 per maund of seed-cotton.	117,150	318,325	435,475	..	..	582,000	
	American 285 F	Spins finer than 4 F and also more drought resistant and earlier.	4,880	16,020	20,900	15,750	5,500	21,250	
	Desi No. 24	Improved *desi* variety	1,000	..	1,000	18,000	3,000	21,000	
	White-flowered Neglectum.	More yield and higher lint percentage	32,405	..	32,405	24,800	18,904	43,704	
	Sugarcane (Bihar and Coimbatore 205).	High yield	72	5,014	5,086	96	6,589	6,685	

Bombay	Cotton—								
	1027 A. L. F.	The lint is sold at a premium	140,500	250,000	390,500	112,485	205,000	317,485	Includes area under other improved varieties of cotton.
	Neglectum roseum	Heavy yield, pure type, better ginning percentage.	27,762	200,000	227,762	20,815	275,000	295,815	
	Dharwar Nos. 1 & 3	Give increased profit	5,730	38,395	44,125	74,963	20,000	94,963	
	Gadag No. 1		7,136	38,320	45,456	65,044	40,000	105,044	
	American	Prolific, early and hardy	1,000	6,000	7,000	16,000	1,000	17,000	
	Desi 27 W. N.	Prolific, special rough feel, bright colour	700	..	700	3,672	..	3,672	
	Groundnut	Gives increased profit, matures early	75	116,234	116,309	50	157,362	157,412	
	Sugarcane (Red Mauritius).	Gives about 15 per cent. better yield with the advantage of ratoon crops.	125	1,275	1,400	120	1,500	1,620	Includes area under Manjav also.
	Bajra (Akola variety)	Better quality grain and higher yield	50	44,000	44,050	500	49,000	49,500	
	Wheat (Pusa 4 and 12)	Better yield and less affected by smut	1,855	1,030	2,885	3,524	8,076	11,600	
	Rice (various selected strains of Kolamba).	Higher yielding capacity	..	..	1,200	8,050	4,125	12,175	
Madras	Paddy	Better yielders and more profitable to cultivators.	24,610	153,562	178,172	163,269	2,900	166,169	
	Sugarcane	Do. do.	2,486	4,553	7,039	5,450	..	5,450	
	Cotton	Do. do.	62,554	89,192	151,746	198,525	65,000	263,525	
	Miscellaneous	Do. do.	12,778	10,445	23,223	9,931	36,300	46,231	
Central Provinces	Wheat	Better yielders	..	..	60,222	..	..	62,473	
	Paddy	Do.	..	..	69,776	..	..	95,577	
	Cotton	Do.	..	..	281,224	..	..	545,640	
	Juar	Do.	..	..	21,531	..	..	69,942	
	Groundnut	Do.	..	..	10,671	..	..	11,599	
	Other crops	Do.	..	..	3,306	..	..	4,222	

Areas under new and improved varieties of crops during the year 1923-24—concld.

Name of Province	Name of crop	Advantages	Area in acres						Remarks
			1922-23			1923-24			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Burma	Paddy	Uniformity and freedom from red grain. High milling capacity.	..	..	100,000	..	..	137,947	
	Groundnut	High oil capacity. Earlier. Easy to harvest	..	..	5,000	..	..	8,888	
	Cotton (Indigenous selection and Cambodia).	More profitable to cultivate	..	..	6,000	..	..	6,348	
	Gram	Immunity to wilt disease	..	..	30,000	..	..	31,100	
Assam	Paddy	Higher yielders than *desi* varieties	..	..	9,011	1,693	2,162	3,855	
	Jute		..	..	1,207	596	233	829	
	Sugarcane		..	..	2,055	797	..	797	
	Potato		..	..	183	158	79	237	
North-West Frontier Province.	Wheat (Pusa 4)	Ripens early, does not lodge, resists rust	..	..	200,000	.	..	202,000	
	Sugarcane (Red Assami)	Ripens early, vigorous in growth, little affected by disease or borers	..	..	50	..	..	500	
	Berseem	Yields better than shaftal	..	..	400	..	..	2,500	

APPENDIX II.

List of Agricultural Stations in British India in 1923-24.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
ombay	Surat	292	Superintendent	Deputy Director of Agriculture, Gujarat, Surat.	
	Amalsad	19	Overseer		
	Nadiad	44	Tobacco Breeder		
	Broach	6	....		
	Dohad	57	Superintendent		
	Dhulia	28	District Agricultural Overseer.	Deputy Director of Agriculture, North Central Division, Nasik.	
	Jalgaon	214	Superintendent		
	Kopargaon	115	Ditto	Deputy Director of Agriculture, South Central Division, Poona.	Mainly a fodder farm for famine use. (A small portion is utilized as a sugarcane station.)
	Baramati	21	Ditto		Sugarcane farm.
	Manjri	62	Ditto		Sugarcane experimental station.

List of Agricultural Stations in British India in 1923-24—contd.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bombay—*concld.*	Dharwar	134	Superintendent	Deputy Director of Agriculture, Southern Division, Dharwar.	
	Gokak Canal	62	Ditto		
	Tegur	370	Fieldman		
	Chharodi	2,300	Manager	Deputy Director of Agriculture for Animal Breeding, Poona.	Cattle-breeding farms.
	Bankapur	112	Ditto		
	Karachi (Lord Willingdon cattle farm).	...	Ditto		
	Ratnagiri	93	Superintendent	Deputy Director of Agriculture, Konkan, Ratnagiri.	
	Kumta	184	Ditto		
	Karjat	6	Rice Specialist		Rice research station.
	Karjat	9	Superintendent	Plant Breeding Expert, Poona.	Ditto.
	Mirpurkhas	200	Ditto	Deputy Director of Agriculture, Sind, Karachi.	Seed farm.
	Mirpurkhas	60	Ditto		
	Sukkur	30	Ditto		
	Larkana	65	Ditto		Utilized as an adjunct to the Lord Willingdon Cattle Farm near Karachi.
	Landhi	24	Ditto		
	Jacobabad	300	Ditto		

Madras	Ganeshkhind, Kirkee	80	Ditto	Horticulturist to Government, Poona.	Agricultural and botanical station. Horticultural course is given here.
	Modi Bag, Poona	14	Ditto		Teaching garden.
	Poona	185	Professor of Agriculture, Poona.	Professor of Agriculture, Poona Agricultural College.	Agricultural College farm.
	Kirkee	362	Manager		Agricultural College dairy.
	Coimbatore	440	Manager	Superintendent, Central Farm, Coimbatore.	Central farm attached to the Agricultural College.
	Samalkota	57	Ditto	Deputy Director of Agriculture, I Circle, Cocanada.	
	Anakapalli	41	Ditto		
	Guntur	150	Ditto	Deputy Director of Agriculture, II Circle, Guntur.	
	Hagari	225	Ditto	Deputy Director of Agriculture, III Circle, Bellary.	
	Nandyal	102	Ditto		
	Palur	64	Ditto	Deputy Director of Agriculture, IV Circle, St. Thomas's Mount.	
	Koilpatti	125	Ditto	Deputy Director of Agriculture, VI Circle, Madura.	
	Kasargod	106	Ditto	Deputy Director of Agriculture, VII Circle, Tellicherry.	West Coast coconut station.
	Taliparamba	86	Ditto		
	Nanjanad, The Nilgiris	36	Ditto	Deputy Director of Agriculture, VIII Circle, Coimbatore.	Seed potato farm.

List of Agricultural Stations in British India in 1923-24—contd.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Madras—*concld.*	Tenmalai (Travancore)	20	Manager	Deputy Director of Agriculture, Planting Districts, Coimbatore.	Rubber stations.
	Mooply (Cochin)	20	Ditto		Rubber stations.
	Sidapur (Coorg)	19	Ditto		Coffee station.
	Peermade (Travancore)	20	Ditto		Tea station.
	Chintaladevi	850	Ditto	Deputy Director of Agriculture, Live-stock, Hosur.	Cattle farm.
	Coonoor	...	Assistant Farm Manager	Curator, Government Botanic Gardens, Ootacamund.	Pomological station.
	Dacca	354	Chief Superintendent	Deputy Director of Agriculture, Eastern Circle.	
	Mymensingh	20	District Agricultural Officer.		
	Faridpur	20	Ditto		
	Comilla	20	Ditto		
	Barisal	20	Ditto		
	Jamalpur (Mymensingh)	7	Ditto		
	Dhanbari	21	Ditto		
	Kishoregunj	200	Ditto		
	Rajshahi	63	Superintendent		
	Rangpur	333	Ditto		Cattle farm.

Bengal	Rangpur	19	District Agricultural Officer	Deputy Director of Agriculture, Northern Circle.	Demonstration farm.
	Burirhat (Rangpur)	52	Superintendent		Tobacco farm.
	Bogra	23	District Agricultural Officer		
	Pabna	20	Ditto		
	Chinsura	210	Chief Superintendent	Deputy Director of Agriculture, Western Circle.	
	Burdwan	32	District Agricultural Officer		
	Jessore	20	Ditto		
	Gosaba	10	Superintendent	Deputy Director, Western Circle, and Superintendent, Burdwan Division.	
	Berhampore	45	District Agricultural Officer		
	Bankura	29	Ditto		
	Suri	33	Ditto		
	Kalimpong	76	Manager	Director of Agriculture, Bengal.	
	Kalimpong, Kurseong and Berhampore.	...	Superintendent of Sericulture.	Deputy Director of Sericulture.	Sericultural research stations.
	Khulna Demonstration Garden.	..	District Agricultural Officer	District Agricultural Association.	
	Ranaghat Mullick Agricultural Farm.	333	..	Rai Kumud Nath Mullick Bahadur.	Private farm.
	Jaydebpur Demonstration Farm, Dt. Dacca.	3	Demonstrator	Bhawal Wards' Estate	Ditto.
	Brahmanberia Farm	4	..	Sharail Wards Estate.	Under the supervision of Bengal Agricultural Department.
	Baratia Farm	7	..	6 annas Court of Wards' Estate, Santosh, Tangail, Mymensingh	Ditto.
	Noakhali Farm	110	Court of Wards' Demonstrator.	..	

List of Agricultural Stations in British India in 1923-24—contd.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bihar and Orissa	Sabour	190	Manager	Professor of Agriculture.	
	Jamui	38	Inspector		
	Banka	26	Overseer		
	Monghyr	200	Ditto		Dairy farm.
	Gaya	193	Manager	Deputy Director of Agriculture, Patna Circle, Patna.	
	Nawada	67	Inspector		
	Bikramganj	24	Overseer		
	Kanke	140	Manager	Deputy Director of Agriculture, Chota Nagpur Circle, Kanke, Ranchi.	Potato farm.
	Netarhat	193	Overseer		
	Purulia	52	Inspector		
	Ramgarh	43	Overseer		
	Chianki	32	Ditto		
	Sambalpur	32	Inspector		
	Cuttack	150	Probationary Assistant Director of Agriculture.	Deputy Director of Agriculture, Orissa Circle, Cuttack.	
	Khurda	31	Manager		
	Balasore	80	Overseer		

	Angul	25	Ditto		
	Sepaya	379	Probationary Assistant Director of Agriculture.	Deputy Director of Agriculture, North Bihar Range.	Cattle-breeding farm and sugarcane station
United Provinces	Cawnpore	58	Superintendent	Deputy Director of Agriculture, Central Circle, Cawnpore, and Divisional Superintendent of Agriculture.	
	Kalianpur (Cawnpore)	260	Ditto		
	Atarra (Banda)	171	Ditto		
	Etawah	62	Ditto		
	Hardoi	40	Ditto		
	Mainpuri	53	Ditto		
	Jaitpur (Hamirpur)	31	Overseer		
	Partabgarh	90	Superintendent	Deputy Director of Agriculture, Eastern Circle, Partabgarh.	
	Naugawan (Sultanpur)	386	Ditto		
	Fyzabad	206	Ditto		
	Benares	78	Ditto	Divisional Superintendent of Agriculture.	
	Aligarh	88	Ditto	Deputy Director of Agriculture, Western Circle, Aligarh, and Divisional Superintendent of Agriculture.	
	Muzaffarnagar	109	Ditto		
	Muttra	56	Inspector		
	Agra	100	Ditto		
	Bulandshahr	25	Ditto		
	Aligarh (Kalai)	142	Superintendent		
	Gorakhpur	110	Overseer	Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur.	
	Bahraich	21	Ditto		

List of Agricultural Stations in British India in 1923-24—contd.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
United Provinces—*concld.*	Shahjahanpur	164	Superintendent	Deputy Director of Agriculture, Rohilkhand Circle.	
	Nawabganj (Bareilly)	119	Ditto		
Punjab	Lyallpur—Agricultural Farm.	473	Manager	Professor of Agriculture, Punjab, Lyallpur.	
	Students' Farm	78			
	Botanical Farm	120		Economic Botanist to Government, Punjab, Lyallpur.	
	Montgomery	250	Ditto	Professor of Agriculture, Lyallpur, and Extra Assistant Director of Agriculture.	Mainly a seed farm.
	Gurdaspur	161	Ditto	Deputy Director of Agriculture, 1st Circle.	Experimental Station.
	Sargodha	657	Ditto		Seed farms
	Chillianwalla	250	Ditto		
	Beas	43	Ditto		
	Hansi	589	Ditto	Deputy Director of Agriculture, 2nd Circle.	Experimental Station.
	Harappa Road	558	Ditto	Deputy Director of Agriculture, Lyallpur.	For reclamation of saline soils.
	Mandalay	619	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, Northern Circle.	
	Padu	29	Senior Agricultural Assistant.		
	Hopin	33	Ditto		

Burma	Tatkon	45	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, East Central Circle.	
	Yawnghwe	36	Ditto		
	Mahlaing	244	Superintendent, Assistant Director of Agriculture.	Deputy Director of Agriculture, Myingyan Circle.	
	Taungtha	16	Junior Agricultural Assistant.		
	Allanmyo	143	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, West Central Circle.	
	Pwinbyu	22	Junior Agricultural Assistant.		
	Hmawbi	454	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, Southern Circle.	
	Nyaunglebin	16	Junior Agricultural Assistant.		
	Zigon	21	Ditto		
	Akyab	128	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, Arakan Circle.	
Central Provinces	Nagpur	268	Superintendent	Principal, Agricultural College, Nagpur.	College farm.
	Akola	271	Ditto	Economic Botanist, Nagpur.	
	Borgaon	368	Ditto	Deputy Director of Agriculture, Western Circle, Amraoti.	
	Yeotmal	106	Ditto		
	Khandwa	177	Ditto		
	Basim	109	Ditto		

List of Agricultural Stations in British India in 1923-24—concld.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Central Provinces —*concld.*	Sindewahi	197	Superintendent	Deputy Director of Agriculture, Southern Circle, Nagpur.	
	Tharsa	116	Ditto		
	Wara-Seoni	63	Ditto		
	Telinkheri	1,000	Ditto	Deputy Director of Agriculture in charge Animal Husbandry, Nagpur.	Dairy farm.
	Raigarh (Garhi)	1,200	Ditto		Cattle-breeding farm.
	Chandkhuri	333	Ditto	Deputy Director of Agriculture, Eastern Circle, Raipur.	
	Bilaspur	253	Ditto		
	Drug	281	Ditto		
	Raipur	229	Ditto		
	Powarkhera (Hoshangabad).	528	Ditto	Assistant Director of Agriculture, Chhindwara.	
	Seoni	164	Ditto		
	Chhindwara	69	Ditto		
	Betul	161	Ditto		
	Adhartal (Jubbulpore)	637	Ditto	Deputy Director of Agriculture, Northern Circle, Jubbulpore.	
	Saugor	161	Ditto		
	Damoh	152	Ditto		

Assam	Jorhat	59	Manager		Sugarcane station.
	Titabor	120	Ditto	Deputy Director of Agriculture, Assam.	Rice station.
	Upper-Shillong	367	Ditto		Potato station.
	Karimganj	80	Ditto		Rice station.
North-West Frontier Province.	Tarnab (Peshawar)	200	Ditto	Agricultural Officer, North-West Frontier Province, Peshawar.	
	Hazipur	20	Ditto		
Imperial Department of Agriculture.	Pusa	616	Overseer	Imperial Agriculturist.	
	Bangalore	258	Superintendent	Imperial Dairy Expert	Dairy farms.
	Wellington	62	Ditto		
	Karnal	2,164	Ditto		

APPENDIX III.

Showing results of well-boring during 1923-24.

Name of Province	1923-24		1922-23	
	Number of bores	Number successful	Number of bores	Number successful
United Provinces	608	471	624	457
Punjab	248	208	301	245
Bombay	197	127	80	46
Madras	625	354	451	215
Central Provinces	12	7	21	15
Bengal	5	5	5	5
Bihar & Orissa	71	71	114	84

APPENDIX IV.

Showing sale of improved implements through departmental agency during 1923-24.

Name of Province	Ploughs		Cane mills		Fodder cutters		Hoes		Other implements		Spare parts	
	1923-24	1922-23	1923-24	1922-23	1923-24	1922-23	1923-24	1922-23	1923-24	1922-23	1923-24	1922-23
United Provinces . . .	1,422	1,318	95	49	27	18	44	83	164	176	2,818	2,433
Punjab	8,415	2,683	220	533	538	224	45	80	1,274	515	1,739	709
Bombay	987	782	60	16	4,872	..	25	7	113	1,192	263	72
Madras	1,341	613	63	85	5	..	23	7	271	98	834	28
Central Provinces . .	7,966	1,983	107	112	36	8	339	143	296	291	3,186	2,345
Bengal	18	16	15	2	..	..	..	34	4	3	..	..
Assam	1	6	182	206	..	..	..	4	75	74	..	..
Burma	57	10	6	..	..	..	..	..	32	2	359	21
North-West Frontier Province .	20	..	..	..	..	..	1	..	..	..	50	..

APPENDIX V.

Agricultural Colleges and Schools in British India during 1923-24.

Name of College or School	Courses of instruction	1923-24				1922-23				Remarks
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
1	2	3	4	5	6	7	8	9	10	11
					(a) Post-graduate Training Institutions.					
Agricultural Research Institute, Pusa.	(1) Post-graduate (New Course).	40	2	2	..	..	..	..	..	In addition, 7 students received short courses of training in 1923-24.
	(2) Post-graduate (Old Course).	..	1	7	4	7	7	11	5	
Imperial Institute of Animal Husbandry and Dairying, Bangalore.	(1) Post-graduate Course in animal husbandry and dairying—15 months.	..	5	5	..	..	..	..	..	Newly started on 2nd January 1924.
	(2) Indian Diploma course in dairying (2 years).	190	15	15	..	..	..	..	..	
					(b) Provincial Agricultural Colleges.					
Poona Agricultural College.	(1) Three-year B. Ag. Degree course.	93	70	70	45 ..	99	53	161	38 5	Affiliated to the University of Bombay.
	(2) College Diploma course.									
	(3) One-year Special course.	..	..	..	..	..	..	..	5	
Agricultural College, Coimbatore.	(1) Degree course—3 years.	68	7	32	8	126	20	14	11	Affiliated to the University of Madras.
	(2) Old Diploma course —3 years.	..	..	..	..	..	..	18	18	
	(3) Certificate course—2 years.	61	12	34	20	88	27	43	16	
Agricultural College, Nagpur.	(1) Three and half years' Diploma course for the Licentiate of Agriculture.	89	65	54	3	72	35	58	5	
	(2) Two years' Certificate course.	26	12	21	13		11	17	17	

Agricultural College, Cawnpore.	(1) Diploma (L.Ag.) course of 4 years.	48	21	68	11	74	34	64	8	
	(2) Two years' or Vernacular course.	80	24	49	20	109	36	59	27	
Punjab Agricultural College, Lyallpur.	(1) B.Sc. Agri. course—4 years. (2) M.Sc. Agri. course . (3) Leaving Certificate course—2 years.	180	53	148	30	300	53	145	80	Affiliated to the University of Punjab.
	(4) Vernacular course—6 months.	28	17	17	11	32	30	24	24	
	(5) Rural Economy course—1 month.	28	24	24	24	..	20	20	20	
	(6) Teachers' Training course—10½ months.	9	9	9	9	..	12	12	12	
Agricultural College and Research Institute, Mandalay.	Two years' Certificate course and 4 years' Diploma course.	143	24	24	..	..	..	..	..	Opened on 1st July 1924.
Bengal				(c) *Agricultural High and Middle Schools.*						
Secondary Agricultural School, Dacca.	The new curriculum includes agriculture, rural engineering, veterinary hygiene, book-keeping and rural economics.	57	14	12	5	276	13	10	..	
Secondary Agricultural School, Chinsura.		..	..	..	..	..	27	16	16	Abolished in 1923-24.
Bimala Agricultural High English School, Amarpur, District Burdwan.	Students are taught agriculture, both theoretical and practical from class V to X.	80	62	212	..	..	22	95	32	There are 212 boys out of whom 151 receive training in agriculture.
Durgapur High English School, District Chittagong.	Ditto . .	16	16	48	20	9	9	55	33	
Central Provinces.										
Agricultural Midd'e School, Powarkhera.	2 years' course . .	..	21	18	6	8	8	12	4	
Agricultural Middle School, Chandkhuri.	Ditto . .	..	11	8	2	3	3	7	3	
Madras.										
Agricultural Middle School, Taliparamba.	2 years' course in vernacular.	25	14	31	14	18	18	18	No exam.	
Agricultural Middle School, Anakapalle.	Ditto . .	6	6	11	5	7	7	7	Ditto	
Burma.										
Agricultural School, Pyinmana .	4 years' course . .	..	35	57	22	39	39	29	..	The school is run by the American Baptist Mission.

Agricultural Colleges and Schools in British India during 1923-24—concld.

Name of College or School	Courses of instruction	1923-24				1922-23				REMARKS
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
1	2	3	4	5	6	7	8	9	10	11
Bombay.					(*d*) *Vernacular Agricultural Schools.*					
Vernacular Agricultural School, Lonikalbhor (in Marathi).	2 years' course . .	61	18	39	19	61	27	49	22	
Vernacular Agricultural School, Devi-hosur (in Kanarese).	Ditto . .	50	14	24	8	30	10	21	10	Practical training in weaving, rope making, etc., is also given.
Vernacular Agricultural School, Jambul (in Marathi).	Ditto. . .	18	14	17	6	5	5	25	13	
Vernacular Agricultural School, Godhra (in Gujarati).	Ditto . .	50	18	31	13	35	15	28	11	
Vernacular Agricultural School, Dhulia, West Khandesh (in Marathi).	Ditto . .	36	18	28	No exam.	40	20	17	..	
Vernacular Agricultural School, Surat (in Gujarati).	Ditto . .	19	13	13	Ditto	..	..	..	..	Started during 1923-24.
Central Provinces.										
Vocational class, Akola .	6 months' course . .	..	..	..	..	11	11	11	11	Not in operation during 1923-24.
Bihar and Orissa.										
Vernacular Agricultural School, Pathra (Godda), District Santal Parganas.	Practical training in general agriculture, spinning, etc.	..	..	..	40	..	..	75	..	Attached to the C. M. S. Mission Upper Primary School.
United Provinces.										
Vernacular Agricultural School, Bulandshahr.	2 years' course . .	28	19	43	22	49	24	48	24	

APPENDIX VI.

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1923-24.

The two tables below include Agricultural Societies for—

A. 1. *Purchase, and Purchase and Sale.* These are societies intended to facilitate the purchase of agricultural requisites for members, such as societies which purchase seed, manure, implements, etc., for sale to their members. Societies of this character which collect for joint sale the produce of members without making this their main object are also included in this class.

2. *Production.* These are societies which have for their chief object an act of production without proposing to themselves sale as a direct object. These also include societies for joint irrigation, for collective use of machinery, for assistance in horse and cattle breeding, etc.

3. *Production and Sale.* This class includes societies in which these two functions are united or in which one or the other predominates, it being impossible to make a clear distinction between them. It covers all societies whose main object is the joint sale of any commodity whether such commodity is produced or worked up or prepared for sale by the society itself or by the members individually. It comprises all co-operative creameries and distilleries, as well as societies whose main object is the sale of grain, cattle, eggs, *ghi*, etc., produced by their members.

4. Other forms of co-operation except insurance.

B. Insurance.

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1923-24—contd.

(A) *Purchase, Sale and Production.*

Province	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit and loss for the year	Remarks
				Rs.	Rs.	Rs.	Rs.	
Bombay	Purchase and Purchase and Sale.	87	4,155	56,164	30,831	2,05,883	+4,475	
	Production	19	542	..	..	15,235	+1,185	
	Production and Sale	55	7,265	4,51,088	11,19,574	8,01,673	+36,250	
	Others	29	4,208	2,618	2,933	99,599	+17,084	
	TOTAL	190	16,170	5,09,870	11,53,338	11,22,390	+58,994	
Madras	Purchase and Purchase and Sale.	77	8,002	2,56,030	1,05,170	4,24,012	—27,987	
	Production and Sale	4	334	...	...	1,26,214	—12,223	
	Others	122	7,232	...	...	37,343	+1,031	
	TOTAL	203	15,568	2,56,030	1,05,170	5,87,569	—39,179	
Bengal	Purchase and Purchase and Sale.	22	4,441	1,75,439	1,08,620	1,56,149	+3,620	
	Production	173	7,376	13	2	1,24,651	—7,120	
	Production and Sale	58	5,819	11,04,869	6,94,697	7,74,087	+2,77,239	
	Others	17	291	746	247	5,140	—597	
	TOTAL	270	17,927	12,81,067	8,03,566	10,60,027	+2,73,142	

Bihar and Orissa.	Purchase and Sale	9	411	12,376	12,999	11,951	—721
	Production and Sale	27	400	7,775	1,610	17,976	—5,806
	TOTAL	36	811	20,151	14,609	29,927	—6,527
United Provinces.	Purchase and Purchase and Sale.	1	73	944	...	6,793	—256
	Production	1	58	...	...	1,690	—1,226
	Production and Sale	6	212	...	5,346	20,946	+575
	TOTAL	8	343	944	5,346	29,429	—907
Punjab	Purchase and Purchase and Sale.	21	918	20,544	....	22,875	—3,204
	Production	62	1,211	...	...	4,453	+70
	Production and Sale	21	1,756	10,38,423	28,15,947	3,48,666	+7,305
	Others	252	10,688	...	...	53,241	+2,367
	TOTAL	356	14,573	10,58,967	28,15,947	4,29,235	+6,538
Burma	Purchase and Sale	17	1,077	29,109	...	13,163	—1,989
	Production	6	163	...	...	...	...
	Production and Sale	74	9,046	5,39,571	4,17,336	6,26,593	—98,799
	TOTAL	97	10,286	5,68,680	4,17,336	6,39,756	—1,00,788

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1923-24—concld.

(A) *Purchase, Sale and Production*—concld.

Province	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit and loss for the year	Remarks
				Rs.	Rs.	Rs.	Rs.	
Central Provinces and Berar.	Purchase and Sale.	7	682	43,304	837	36,954	+4,800	
	Purchase and Production	20	252	679	...	2,126	—112	
	Production and Sale	1	186	189	...	11,401	+877	
	Total	28	1,121	44,172	837	50,481	+5,565	

(B) *Cattle Insurance.*

Province	Number of societies	Amount of risk insured	Premia collected during the year	Supplementary contributions collected	Number of animals		Claims paid	Cost of management	Funds in hand at end of year	Amount of risk re-insured	Amount of premia paid for re-insurance
					Insured	Lost					
		Rs.	Rs.	Rs.			Rs.	Rs.	Rs.	Rs.	Rs.
Bombay	9	10,720	605	40	145	9	149	93	1,579	...	...
Punjab	29	5,080	127	45	100	2	127	182	4,457	2,540	64
	1*	2,540	123	...	26	1	17	72	1,235	...	...
Burma	397	83,684	2,899	22	1,770	42	2,556	266	34,320	43,198	1,373
	1*	43,198	1,239	...	2,736	54	581	836	16,799	...	...
United Provinces	1	1,133	35	...	20	1	65	...	29	...	...

* Central Re-insurance Society.

APPENDIX VII.

Showing the working of the Provincial Civil Veterinary Departments during 1923-24.

Province	Reported mortality			Dispensaries and hospitals		District work				
	Rinderpest	Other diseases	Total	Hospitals and dispensaries	Cases treated and castrations performed	Cases treated and castrations performed	Outbreaks in which inoculation was undertaken	Deaths uninoculated	Inoculations	Deaths after inoculation
Bombay	5,166	6,291	11,457	83	143,521	39,600	249	4,038	25,097	126
Madras	3,434	19,779	23,213	72	91,750	46,874	131	1,802	18,540	52
Bengal	24,944	2,445	27,389	41	50,253	75,657	1,178	17,973	204,209	1,102
Bihar and Orissa	14,574	6,156	20,730	28	37,895	63,330	1,070	6,545	145,593	479
United Provinces	2,703	6,057	8,760	126	190,640	57,120	368	5,010	40,990	48
Punjab	12,460	26,942	39,402	177	616,277	141,219	1,091	7,042	269,597	69
Burma	16,768	3,373	20,141	5	9,740	58,945	345	2,613	36,182	178
Central Provinces	2,631	12,161	14,792	87	242,184	296,275	227	1,873	23,244	58
Assam	10,065	15,465	25,530	3	5,481	63,366	304	5,661	24,843	243
North-West Frontier Province	393	790	1,183	19	52,374	42,463	63	173	14,114	2
Sind	2,944	1,937	4,881	17	27,070	3,218	89	1,496	9,432	135
Baluchistan	...	3,450	3,450	8	10,860	3,658	...	94	300	21
Rajputana	..	34	34	2	2,390	1,749	...	...	...	..
TOTAL FOR 1923-24	96,082	104,880	200,962	668	1,480,435	893,474	5,115	54,320	812,141	2,573
TOTAL FOR 1922-23	98,235	113,695	211,930	642	1,398,877	858,950	5,119	52,011	679,195	3,171

F 2

APPENDIX VIII.

Showing the details as to students of Veterinary Colleges and Schools in India during 1923-24.

Veterinary College or School	Course of instruction	Number of students						Students admitted during the year, classed by educational qualifications		
		Admitted during the year		Passed final examination during the year	Failed to pass final examination	Remaining under instruction at end of the year		Matriculates, school finals or with higher qualifications	Knowing some English but not matriculates	Knowing no English or very little English
		Scholarship-holders	Others			In ordinary course	Instruction prolonged by reason of failure to pass			
1	2	3	4	5	6	7	8	9	10	11
Bombay Veterinary College	3 years' English course.	14	11	16	4	58	7	12	13	...
Madras „ „	Do.	15	8	21	7	42	20	23	...	...
Bengal „ „	Do.	25	16	29	17	72	30	30	11	...
Punjab „ „	Post Diploma course.	...	1	1	...	...	...	...	1	...
	4 years' English course.	..	37	...	...	16	10	37	...	...
	3 years' Vernacular course.	..	...	15	7	...	7	...	...	...
Insein Veterinary School	Do.	15	...	14	...	45	...	...	...	15
Taunggyi „ „	1½ Do.	2	6	...	...	8	...	...	1	7

APPENDIX IX.

Showing the number of cattle issued from Government farms during 1923-24.

Province	Bulls	Cows	Male buffaloes	She buffaloes	Young stock	Total for 1923-24	Total for 1922-23	Remarks
United Provinces	72	..	6	..	..	78	58	
Punjab	241	8	2	..	115	366	293	
Bombay	36	15	3	..	12	66	142	
Madras	40	19	1	1	15	76	14	
Central Provinces	46	125	..	15	128	314	316	
Bengal	8	28	..	15	9	60	10	
Bihar and Orissa	3	3	..	..	17	23	54	
Assam	5	8	..	..	13	26	4	
North-West Frontier Province	1	1	1	..	..	3	12	
Burma	2	..	..	..	..	2	..	
Imperial Farms.								
Pusa	1	6	..	..	26	33	92	
Bangalore	2	8	..	..	6	16	..	
Wellington	2	5	..		20	27	..	

APPENDIX X.

List of Agricultural Publications in India during 1923-24.

No.	Title	Author	Where published
	GENERAL AGRICULTURE.		
1	The *Agricultural Journal of India*, Vol. XVIII, Parts IV, V and VI, and Vol. XIX, Parts I, II and III. Price R. 1-8 or 2*s.* per part; annual subscription Rs. 6 or 9*s.* 6*d.*	Edited by the Agricultural Adviser to the Government of India, Pusa.	Messrs. Thacker, Spink & Co., Calcutta.
2	Scientific Reports of the Agricultural Research Institute, Pusa (including the Reports of the Imperial Dairy Expert and the Secretary, Sugar Bureau) for 1922-23. Price R. 1.	Issued from the Agricultural Research Institute, Pusa.	Government Printing, India, Calcutta.
3	Review of Agricultural Operations in India, 1922-23. Price R. 1-10.	Agricultural Adviser to the Government of India, Pusa.	Ditto
4	Proceedings of the Board of Agriculture in India held at Bangalore on the 21st January, 1924, and following days, with Appendices. Price R. 1.	Issued by the Agricultural Adviser to the Government of India.	Ditto
5	Proceedings of the Cattle Conference held at Bangalore on 22nd and 23rd January, 1924, with Appendices. Price As. 9.	Ditto	Ditto
6	A Study of the Factors operative in the value of Green Manure. Pusa Agricultural Research Institute Bulletin No. 149. Price As. 5.	B. H. Wilsdon, M.A., I.E.S., late Agricultural Chemist to Government, Punjab; P. E. Lander, M.A., D.Sc., A.I.C., I.A.S., Agricultural Chemist to Government, Punjab, Lyallpur; and M. Mukand Lal, L.Ag., Research Assistant, Agricultural College, Lyallpur.	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
7	The Improvement of Fodder and Forage in India (Papers read before a joint meeting of the Sections of Agriculture and Botany, Indian Science Congress, Lucknow, 1923). Pusa Agricultural Research Institute Bulletin No. 150. Price As. 6.	Edited by Gabrielle L.C. Howard, M.A., Second Imperial Economic Botanist, Pusa.	Government Printing, India, Calcutta.
8	Annual Report of the Board of Scientific Advice for India for 1922-23. Price R. 1.	Issued by the Board of Scientific Advice for India.	Ditto
9	Estimates of Area and Yield of Principal Crops in India, 1922-23. Price As. 12.	Issued by the Department of Statistics, India.	Ditto
10	Agricultural Statistics of India, 1921-22, Vol. I. Price R. 1-2	Ditto	Ditto
11	Agricultural Statistics of India, 1921-22, Vol. II. Price As. 15.	Ditto	Ditto
12	Quinquennial Report on the Average Yield per Acre of Principal Crops in India for the period ending 1921-22. Price As. 8.	Ditto	Ditto
13	Agricultural Statistics of Bengal for 1922-23.	Government of Bengal, Agriculture and Industries Department.	Bengal Government Press, Calcutta.
14	Report on the Operations of the Department of Agriculture, Bengal, for the year 1922-23. Price Rs. 3.	Issued by the Department of Agriculture, Bengal.	Ditto
15	Season and Crop Report of Bengal for 1923-24. Price R. 1-14.	Ditto	Ditto
16	A Systematic History of the Jute Experiments in Bengal. Bengal Department of Agriculture Bulletin No. 2 of 1921.	R. S. Finlow, B.Sc., Director of Agriculture, Bengal.	Ditto
17	The Reaping of Broadcast Highland Aus Paddy. Bengal Department of Agriculture Leaflet No. 1 of 1924 (English and Bengali).	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
18	Water Hyacinth. Bengal Department of Agriculture Leaflet 2 (English).	R. S. Finlow, B.Sc., Director of Agriculture, Bengal.	Bengal Government Press, Calcutta.
19	Some Paddies experimented upon and found suitable for the East Bengal Soil. Bengal Department of Agriculture Leaflet No. 3 of 1924 (Bengali).	Issued by the Department of Agriculture, Bengal.	Ditto
20	Water Hyacinth, a Manure for Jute. Bengal Department of Agriculture Leaflet No. 4 of 1924.	R. S. Finlow, B.Sc., Director of Agriculture, Bengal.	Ditto
21	On the Improvement of Cattle and Economic Welfare. Bengal Department of Agriculture Leaflet (Bengali).	Issued by the Department of Agriculture, Bengal.	Ditto
22	Reaping of broadcast highland Aus paddy.	Ditto	Ditto
23	Improvement of Cattle and provision of Cattle Fodder in Bengal (in English).	Ditto	Ditto
24	*Bengal Agricultural Journal* (Quarterly). (In English and Bengali.) Annual subscription R. 1-4; single copy As. 5.	Ditto	Sreenath Press, Dacca.
25	Report of the Department of Agriculture, Bihar and Orissa, from 1st July 1922 to 31st March 1923. Price Rs. 2-6.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Printing, Bihar and Orissa, Patna.
26	Season and Crop Report of Bihar and Orissa for 1923-24. Price As. 14.	Ditto	Ditto
27	Agricultural Statistics of Bihar and Orissa for 1922-23. Price R. 1.	Ditto	Ditto
28	Pusa Pedigree Herd in North Bihar. Bihar and Orissa Department of Agriculture Bulletin.	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
29	Report on the Administration of the Department of Agriculture of the United Provinces of Agra and Oudh for the year ending 30th June, 1923.	Issued by the Department of Agriculture, United Provinces.	Government Press, United Provinces, Allahabad.
30	Season and Crop Report of the United Provinces of Agra and Oudh for 1922-23.	Issued by the Department of Land Records, United Provinces.	Ditto
31	Report on the Agricultural Stations in the Western Circle, United Provinces, for the year ending 31st May, 1923.	Issued by the Department of Agriculture, United Provinces.	Ditto
32	Report on the Agricultural Stations in the Central Circle, United Provinces, for the year ending 30th June, 1923. Price As. 10.	Ditto	Ditto
33	Report on the Agricultural Stations in the North-Eastern Circle, United Provinces, for the year ending 30th June, 1923.	Ditto	Ditto
34	Report on the Agricultural Stations in the Eastern Circle, United Provinces, for the year ending 30th June, 1923.	Ditto	Ditto
35	Report on the Working and Administration of the United Provinces Government Gardens for the year 1922-23.	Ditto	Ditto
36	Silage	C. H. Parr, B.Sc., Deputy Director in charge of Cattle Breeding Operations, United Provinces.	Ditto
37	Notes on Upper India Hedges .	A. E. P. Griessen, Deputy Director of Gardens, United Provinces.	Ditto
38	Poultry Farming in the East. Price Rs. 4.	Mrs. A. K. Fawkes, Poultry Expert to the Government of United Provinces.	Pioneer Press, Allahabad.

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
39	Report on the Operations of the Department of Agriculture, Punjab, for the year ending 30th June, 1923, Part I. Price Rs. 2.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
40	Season and Crop Report of the Punjab for the year 1922-23. Price R. 1-8 or 2*s*.	Ditto	Ditto
41	Report on the Operations of the Department of Agriculture, Punjab, for the year ending the 30th June, 1922, Part II. Price Rs. 7-10 or 10*s*. 2*d*.	Ditto	Ditto
42	Tables of Agricultural Statistics of the Punjab for the year 1922-23.	Ditto	Ditto
43	Annual Report of the Lawrence Gardens, Lahore, for 1922-23. Price As. 5-6 or 5*d*.	Ditto	Ditto
44	Prospectus of the Punjab Agricultural College.	Ditto	Ditto
45	Report on the Cotton Survey of the Rohtak District in 1919. Price Rs. 7 or 9*s*. 4*d*.	D. Milne, B.Sc., Economic Botanist to Government, Punjab; Ch. Ali Mohammad, L.Ag., and L. Kirpa Ram, L.Ag., Agricultural Assistants.	Ditto
46	Pamphlet entitled "Possibilities of Agricultural Development in the Punjab."	Sir Patrick Fagan, K.C.I.E., C.S.I.	Ditto
47	Notice for the guidance of Zemindars regarding Seed selection for sowing of Wheat (Urdu).	Issued by the Department of Agriculture, Punjab.	Ditto
48	Notices on "Cotton Seed" for the knowledge of Zemindars of Lower Bari Doab Colony. Punjab Department of Agriculture, Leaflet.	Ditto	Ditto
49	Seasonal Notes of the Punjab Department of Agriculture for May 1924. Price As. 3.	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
50	Notices regarding Cotton Seed White-flowered (Neglectum Bhatla). Punjab Department of Agriculture Leaflet (Urdu).	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
51	Groundnut and its Cultivation. Punjab Department of Agriculture Leaflet No. 13 (revised).	Ditto	Ditto
52	Sugarcane type Coimbatore 205. Punjab Department of Agriculture Leaflet No. 22.	Malik Sultan Ali, I.A.S. Deputy Director of Agriculture, Gurdaspur.	Ditto
53	Clean Picking and Marketing of Cotton. Punjab Department of Agriculture Leaflet No. 23.	Issued by the Department of Agriculture, Punjab.	Ditto
54	Improved *Gur* Boiling Furnaces. Punjab Department of Agriculture Leaflet No. 24.	Malik Sultan Ali, I.A.S., Deputy Director of Agriculture, Gurdaspur.	Ditto
55	Difference between 4F and 285F Punjab American Cotton. Punjab Department of Agriculture Leaflet No. 28.	Issued by the Department of Agriculture, Punjab.	Ditto
56	Shelter Hedges round Cotton Fields. Punjab Department of Agriculture Leaflet No. 29.	Ditto	Ditto
57	Annual Report of the Department of Agriculture, Bombay Presidency, for 1922-23. Price R. 1.	Issued by the Department of Agriculture, Bombay.	Yeravda Prison Press, Poona.
58	Season and Crop Report of the Bombay Presidency for 1922-23. Price As. 8.	Ditto	Government Central Press, Bombay.
59	Triennial Report of the Jacobabad Experimental Station for the years 1919-20, 1920-21 and 1921-22. Price As. 6.	T. F. Main, B.Sc., Deputy Director of Agriculture, Sind.	Ditto
60	The Economic Progress Report of the Rural Areas of the Bombay Presidency, 1911-1922. (For official use only.)	Harold H. Mann, D.Sc., Director of Agriculture, Bombay, Poona.	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
61	Improvement of Grazing Areas in the Bombay Presidency. Bombay Department of Agriculture Bulletin No. 112 of 1923. Price As. 11-6.	L. B. Kulkarni, M.Ag., Assistant Economic Botanist, Poona.	Government Central Press, Bombay.
62	Year Book of the Agricultural Department in Sind. Bombay Department of Agriculture Bulletin No. 113. Price As. 8-6.	Issued by the Department of Agriculture, Bombay.	Ditto
63	Studies on the Rice Plant and on Rice Cultivation. Bombay Department of Agriculture Bulletin No. 114. Price As. 13.	K. V. Joshi, B.Ag., Rice Specialist; and M. V. Gadkari, B.Ag., Assistant to the Rice Specialist, Bombay.	Ditto
64	Shevri as a Fodder Crop. Bombay Department of Agriculture Bulletin No. 115. Price As. 3.	Issued by the Department of Agriculture, Bombay.	Yeravda Prison Press, Poona.
65	Report on the Operations of the Department of Agriculture, Madras Presidency, for the official year 1922-23. Price As. 8.	Issued by the Department of Agriculture, Madras.	Government Press, Madras.
66	Season and Crop Report of the Madras Presidency for 1922-23.	Issued by the Board of Revenue, Madras.	Ditto
67	A Statistical Atlas of the Madras Presidency, 1924. Price Rs. 20.	Ditto	Ditto
68	Year Book of the Madras Agricultural Department for 1923. Price As. 8.	Issued by the Department of Agriculture, Madras.	Ditto
69	Villagers' Calendar, 1924-25 (English, Tamil, Telugu, Malayalam and Kanarese).	Ditto	Ditto
70	The Ground, Earth or Pea-nut (*Arachis hypogœa*). Madras Department of Agriculture Bulletin No. 87. (Revised edition of Bulletin No. 28).	Ditto	Ditto
71	Appendix A to "A Popular Account of the work of the Madras Agricultural Department" (Tamil and Telugu).	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
72	Agricultural Advancement in the Nellore Taluk by Co-operation with the Agricultural Department. Madras Department of Agriculture Leaflet No. 30 (English and Telugu).	Subbarama Reddi of Thotapalli.	Government Press, Madras.
73	Breeding and Rearing of Cattle and Buffaloes. Madras Department of Agriculture Leaflet No. 31 (English, Tamil, Telugu, Malayalam and Kanarese).	R. W. Littlewood, N.D.A., Deputy Director of Agriculture for Live-Stock, Madras.	Ditto
74	Notes on the Exhibits at the Agricultural Exhibition, IV Circle, Madras, comprising North Arcot, South Arcot, Chingleput and Chittoor Districts. Madras Department of Agriculture Leaflet No. 33 (English and Tamil).	D. Ananda Rao, B.Sc., Deputy Director of Agriculture, IV Circle, Madras.	Ditto
75	An Improved Furnance for Jaggery making in Chittoor District. Madras Department of Agriculture Leaflet No. 34 (English, Tamil and Telugu).	Ditto	Ditto
76	Improvement of Paddy Crop with special reference to West Coast. Madras Department of Agriculture Leaflet No. 36 (English and Malayalam).	K. Unnikrishna Menon.	Ditto
77	Cotton Suitable for Cultivation in the Dry Lands of Kurnool District. Madras Department of Agriculture Leaflet No. 37 (Telugu).	P. H. Rama Reddi, M.A., B.Sc., Deputy Director of Agriculture, III Circle, Madras.	Ditto
78	Report on the working of the Department of Agriculture, Central Provinces and Berar, 1922-23. Price R. 1.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Press, Nagpur.
79	Report on the Agricultural College, Nagpur, Botanical, Chemical and Mycological Research, Maharaj Bagh Menagerie and Agricultural Engineer's Section for 1922-23. Price As. 8.	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
80	Season and Crop Report of the Central Provinces and Berar for 1922-23. Price As. 8.	Issued by the Department of Land Records, Central Provinces.	Government Press, Nagpur.
81	Report on the Experimental Farm attached to the Agricultural College, Nagpur, for 1922-23. Price As. 8.	Issued by the Department of Agriculture, Central Provinces and Berar.	Ditto
82	Report on Agricultural Stations, Northern Circle, Central Provinces, for 1922-23. Price Rs. 2.	Ditto	Ditto
83	Report on Demonstration Work in the Northern Circle, Central Provinces, for 1922-23. Price As. 8.	Ditto	Ditto
84	Report on Agricultural Stations, Southern Circle, Central Provinces, for 1922-23. Price R. 1.	Ditto	Ditto
85	Report on Demonstration Work in the Southern Circle, Central Provinces, for 1922-23. Price As. 8.	Ditto	Ditto
86	Report on the Agricultural Stations, Western Circle, Central Provinces, for 1922-23. Price As. 8.	Ditto	Ditto
87	Report on Demonstration Work in the Western Circle, Central Provinces, for 1922-23. Price As. 8.	Ditto	Ditto
88	Report on Agricultural Stations, Eastern Circle, Central Provinces, for 1922-23. Price R. 1-8.	Ditto	Ditto
89	Report on Demonstration work in the Eastern Circle, Central Provinces, for 1922-23. Price As. 8.	Ditto	Ditto
90	Return of expenditure on the Provincial and District Gardens in the Central Provinces and Berar for the year ending 30th June, 1923, Price As. 4.	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
91	Report on the Cattle-breeding Operations in Central Provinces and Berar for 1922-23. Price As. 4.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Press, Nagpur.
92	The Cultivation of Oranges in the Central Provinces and Berar. Central Provinces Department of Agriculture Bulletin No. 19.	K. P. Shrivastava, Assistant to the Economic Botanist, Central Provinces.	Ditto
93	Olpad Thresher. Central Provinces Department of Agriculture Leaflet (Hindi).	E. A. H. Churchill, B.Sc., Assistant Director of Agriculture, Central Provinces.	Ditto
94	Annual Report of the Department of Agriculture, Assam, for the year ending 31st March, 1923. Price As. 8.	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
95	Tables of Agricultural Statistics of Assam for the year 1922-23.	Ditto	Ditto
96	Preservation of Cowdung. Assam Department of Agriculture Leaflet (Assamese).	Ditto	Ditto
97	Proper Methods of covering Cows. Assam Department of Agriculture Leaflet (Assamese).	Ditto	Ditto
98	Report on the Operations of the Department of Agriculture, Burma, for the year ending 30th June, 1923. Price As. 12.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
99	Season and Crop Report of Burma for 1922-23.	Issued by the Department of Settlements and Land Records, Burma.	Ditto
100	Agricultural Statistics of Burma for the year 1922-23. Price R. 1-8.	Issued by the Department of Agriculture, Burma.	Ditto
101	Report of the Agricultural Chemist, Burma, for the year ended the 30th June, 1923. Price As. 6.	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
102	Report of the Economic Botanist, Burma, for the year ended the 30th June, 1923. Price As. 4.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
103	Report by the Entomologist, Mandalay, for the year ended the 30th June, 1923. Price As. 8.	Ditto	Ditto
104	Report of the Agricultural Engineer, Burma, for the year ended the 30th June, 1923. Price As. 4.	Ditto	Ditto
105	Report of the Superintendent, Stock Breeding, Burma, for the year ended the 30th June, 1923. Price As. 4.	Ditto	Ditto
106	Report on the Mandalay Agricultural Station for the year ended the 30th June, 1923. Price As. 6.	Ditto	Ditto
07	Report on the Allanmyo Agricultural Station for the year ended the 30th June, 1923. Price As. 4.	Ditto	Ditto
108	Report on the Hopin Agricultural Station for the year ended the 30th June, 1923. Price As. 4.	Ditto	Ditto
109	Report on the Padu Agricultural Station for the year ended the 30th June, 1923. Price As. 4.	Ditto	Ditto
110	Report on the Yawnghwe Agricultural Station for the year ended the 30th June, 1923. Price As. 4.	Ditto	Ditto
111	Report on the Tatkon Agricultural Station for the year ended the 30th June, 1923. Price As. 8.	Ditto	Ditto
112	Report on the Hmawbi Agricultural Station for the year ended the 30th June, 1923. Price As. 4.	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
113	Report on the Mahlaing Cotton Experimental Station for the year ended the 30th June, 1923. Price As. 4.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
114	Report on the Akyab Agricultural Station for the year ended the 30th June, 1923. Price As. 2.	Ditto	Ditto
115	Report on the Pwinbyu Seed Farm for the year ended the 30th June, 1923. Price As. 4.	Ditto	Ditto
116	Leguminous Crops cultivated for their Roots. Burma Department of Agriculture Leaflet No. 10.	Ditto	Ditto
117	The Cultivation of Coconut in Arakan. Burma Department of Agriculture Leaflet No. 15.	Ditto	Ditto
118	The Commoner Grasses in Burma. Burma Department of Agriculture Bulletin No. 20.	Ditto	Ditto
119	Notes on Tour in the Coconut Planting Districts of Madras Presidency. Burma Department of Agriculture Bulletin No. 22.	Ditto	Ditto
120	Report of the Agricultural Stations at Tarnab and Haripur in the North-West Frontier Province for the year ending 30th June, 1923.	Issued by the Department of Agriculture, North-West Frontier Province.	Government Press, Peshawar.
121	Report on the Season and Crops of the North-West Frontier Province for 1922-23. Price R. 1-1.	Revenue Commissioner, North-West Frontier Province.	Ditto
122	Summary of Remarks on the Kharif Crop of the North-West Frontier Province for 1923. Price As. 6.	Ditto	Ditto
123	Report on the Operations of the Department of Agriculture and Fisheries, Travancore, for 1922-23.	Issued by the Department of Agriculture and Fisheries, Travancore.	Government Press, Trivandrum.

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*concld.*		
124	Report on the Administration of the Village Panchayats and Department of Agriculture in the Cochin State for the year 1922-23.	Issued by the Department of Agriculture, Cochin.	Government Press, Ernakulam.
125	Annual Report of the Agricultural Department, Gwalior State, for 1922-23.	Issued by the Department of Agriculture, Gwalior.	Alijah Darbar Press, Lashkar.
126	Annual Report of the Agricultural Department, Mysore, for the year 1922-23.	Issued by the Department of Agriculture, Mysore.	Government Press, Bangalore
127	Annual Report of the Department of Agriculture, Baroda State, for the year 1921-22.	Issued by the Department of Agriculture, Baroda.	Baroda Printing Office, Baroda.
128	*Quarterly Journal of the Indian Tea Association*, Price As. 6 per copy.	Issued by the Scientific Department of the Indian Tea Association, Calcutta.	Catholic Orphan Press, Calcutta.
129	The *Journal of the Madras Agricultural Students' Union* (Quarterly). Annual subscription Rs. 4.	Madras Agricultural Students' Union, Coimbatore.	Literary Sun Press, Coimbatore.
130	*Indian Scientific Agriculturist.* Annual subscription Rs. 4.	Alliance Advertising Association, Ltd., Calcutta.	Calcutta Chromotype Company, Calcutta.
131	*Poona Agricultural College Magazine* (Quarterly). Annual subscription Rs. 2.	College Magazine Committee, Poona.	Arya Bhusan Press, Poona.
132	The *Planters' Chronicle* (Weekly). Price As. 8 per copy.	United Planters' Association of South India, Coimbatore.	E. P. Works, Coimbatore.
133	*Journal of the Mysore Agricultural and Experimental Union* (Quarterly). Annual subscription Rs. 3.	Mysore Agricultural Experimental Union.	Bangalore Press, Bangalore.
134	*Rural Bengal* (Monthly) . .	N. N. Gupta, B.A., Ph.D., B.Sc., Editor.	Russa Art Press, Bhawanipur, Calcutta.
135	*Krishak* (Bengali) (Monthly). Price As. 5 per copy ; Annual subscription Rs. 3-3.	U. C. Bannerji, Editor.	Sri Ram Press, 162, Bow Bazar Street, Calcutta.
136	The *Old Boys Magazine, Agricultural College, Cawnpore* (Quarterly). Price per copy As. 8 ; Annual subscription Rs. 2.	M. L. Saksena, L.Ag., Editor.	Cawnpore Printing Press.

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	AGRICULTURAL CHEMISTRY.		
137	A Preliminary Note on the Decomposition of Calcium Cyanamide in South Indian Soils. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VII, No. 3. Price As. 12 or 1*s.*	Roland V. Norris, D.Sc., F.I.C., Government Agricultural Chemist, Coimbatore; B. Viswanath, Assistant Agricultural Chemist, Coimbatore; and C. V. Ramaswami Ayyar, L.Ag., Assistant to the Government Agricultural Chemist, Coimbatore.	Messrs. Thacker, Spink & Co., Calcutta.
138	The Prevention of Nuisances caused by the Par-boiling of Paddy. Pusa Agricultural Research Institute Bulletin No. 146. Price As. 5.	J. Charlton, B.Sc., A.I.C., Agricultural Chemist, Burma.	Government Printing, India, Calcutta.
139	A Method for the accurate Determination of Carbonic Acid present as Carbonate in Soils. Pusa Agricultural Research Institute Bulletin No. 151. Price As. 2.	Phani Bhusan Sanyal, M.Sc., Assistant to the Imperial Agricultural Chemist, Pusa.	Ditto
140	Liming of Assam Soils. Assam Department of Agriculture Bulletin No. 2 of 1923.	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
141	Par-boiling of Paddy. Burma Department of Agriculture Leaflet No. 18.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
	BOTANY.		
142	Studies in Inheritance in Cotton, I. History of a Cross between *G. herbaceum* and *G. neglectum*. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XII, No. 3. Price R. 1-4 or 1*s.* 9*d.*	G. L. Kottur, M.Ag., Cotton Breeder, Southern Maharatta Country.	Messrs. Thacker, Spink & Co., Calcutta.
143	Studies in Indian Oil Seeds, No. 2. Linseed. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XII, No. 4. Price R. 1-4 or 2*s.*	Gabrielle L. C. Howard, M.A., Second Imperial Economic Botanist; and Abdur Rahman Khan, Assistant to the Imperial Economic Botanist, Pusa.	Ditto

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	BOTANY—*concld.*		
144	Studies in Gujarat Cottons, Part II. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XII, No. 5. Price R. 1-12 or 3*s.*	Maganlal L. Patel, B.Ag., Cotton Breeder, South Gujarat.	Messrs. Thacker, Spink & Co., Calcutta.
145	Studies in Indian Tobaccos. No. 4—Parthenocarpy and Parthenogenesis in the varieties of *Nicotiana Tabacum* L. var. *Cuba* and var. *Mirodata*. No. 5—The Inheritance of Characters in *Nicotiana rustica*. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIII, No. 1. Price Rs. 2 or 2*s.* 9*d.*	Gabrielle L. C. Howard, M.A., Second Imperial Economic Botanist, Pusa; and Kashi Ram. Gabrielle L. C. Howard, M.A., Second Imperial Economic Botanist, Pusa.	Ditto
146	Practical Botany for Indian Students.	Diwan Bahadur K. Rangachariar, M.A., L.T.	Government Press, Madras.
	MYCOLOGY.		
147	The Wilt Disease of Safflower. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIII, No. 2. Price R. 1 or 1*s.* 6*d.*	S. D. Joshi, B.Sc., Research Assistant, Plant Pathological Section, Department of Agriculture, United Provinces.	Messrs. Thacker, Spink & Co., Calcutta.
148	The Relative Responsibility of Physical Heat and Micro-organisms for the hot weather Rotting of Potatoes in Western India. Pusa Agricultural Research Institute Bulletin No. 148. Price As. 5.	S. L. Ajrekar, B.A., Acting Professor of Botany, Royal Institute of Science, Bombay; and J. D. Ranadive, B.Ag., Assistant Mycologist, Potato Research Committee, Bombay Department of Agriculture.	Government Printing, India, Calcutta.
149	Some common Fungoid Diseases of Crops and their preventive measures—Ufra or Dak Disease of Paddy (in English and Bengali).	Issued by the Department of Agriculture, Bengal.	Bengal Government Press, Calcutta.
150	Earcockle. Punjab Department of Agriculture Bulletin (in Urdu and Gurmukhi). (Reprinted.)	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.

List of Agricultural Publications in India during 1923-24—contd.

No.	Title.	Author	Where published
	MYCOLOGY—*concld.*		
151	Mahali. Madras Department of Agriculture Leaflet No. 35 (in Malayalam).	M. Govind Kidavu, Deputy Director of Agriculture, VII Circle, Madras.	Government Press, Madras.
152	Jowar Smut. Burma Department of Agriculture Cultivators' Leaflet No. 37.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
	ENTOMOLOGY.		
153	Report of the Proceedings of the Fifth Entomological Meeting, held at Pusa from 5th to 10th February, 1923. Price Rs. 9-8.	Edited by T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S., Imperial Entomologist, Pusa.	Government Printing, India, Calcutta.
154	Bee-keeping. Pusa Agricultural Research Institute Bulletin No. 46. (Second Edition.) Price Rs. 2.	C. C. Ghosh, B.A., Assistant to the Imperial Entomologist.	Ditto
155	List of Publications on Indian Entomology, 1922. Pusa Agricultural Research Institute Bulletin No. 147. Price As. 7.	Compiled by the Imperial Entomologist.	Ditto
156	The External Morphology and Bionomics of the commonest Indian Tick (*Hyalomma ægyptium*). Pusa Agricultural Research Institute Bulletin No. 152. Price R. 1.	Mohammad Sharif, M.A., F.R.M.S., Lecturer in Zoology, Muslim University, Aligarh.	Ditto
157	Butterflies of India. Price Rs. 30.	Chas. B. Antram, F.E.S.	Messrs. Thacker, Spink & Co., Calcutta.
158	Lac Cultivation. Bengal Department of Agriculture Bulletin No. 1 of 1924 (English and Bengali).	Issued by the Department of Agriculture, Bengal.	Bengal Government Press, Calcutta.
159	Mango Weevil (English and Bengali).	Ditto	Ditto
160	Cotton Insects. Punjab Department of Agriculture Leaflet Nos. 25, 26 and 27.	M. Afzal Hussain, M.Sc., M.A., Entomologist to Government of Punjab, Lyallpur.	Government Printing, Punjab, Lahore.

List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	ENTOMOLOGY—*concld.*		
161	The Pest Act and Cotton. Madras Department of Agriculture Leaflet No. 32. (English and Tamil).	G. R. Hilson, B.Sc., Cotton Specialist, Madras.	Government Press, Madras.
162	Rats damaging Paddy. Burma Department of Agriculture Leaflet No. 36.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
163	The Important Insect Pests of Coconut. Burma Department of Agriculture Leaflet No. 14. (Revised and enlarged.)	Ditto	Ditto
164	The Palm Beetles in Burma. Burma Department of Agriculture Bulletin No. 19.	Ditto	Ditto
	AGRICULTURAL BACTERIOLOGY.		
165	Indigo Experiments, 1922. (1) The effect on produce when Vat Liquor is allowed to stand in the beating vat and beating is delayed; (2) The effect of neutralizing the Liquor with caustic soda before beating. Pusa Indigo Publication No. 12. Price, As. 4.	J. H. Walton, M.A., M.Sc., Assistant Agricultural Bacteriologist, Pusa.	Government Printing, India, Calcutta.
166	Some Studies in Bio-chemistry.	Some students of Dr. Gilbert Fowler, D.Sc.	The Phœnix Printing House, Bangalore.
	VETERINARY.		
167	Proceedings of the Second Meeting of Veterinary Officers in India, held at Calcutta from 26th February to 2nd March, 1923 (with Appendices). Price Re. 1-12.	Issued by the Agricultural Adviser to the Government of India.	Government Printing, India, Calcutta.
168	Annual Report of the Civil Veterinary Department, Bengal, for 1922-23.	Issued by the Civil Veterinary Department, Bengal.	Bengal Government Press, Calcutta.
169	Annual Report of the Bengal Veterinary College for 1922-23.	Ditto	Ditto

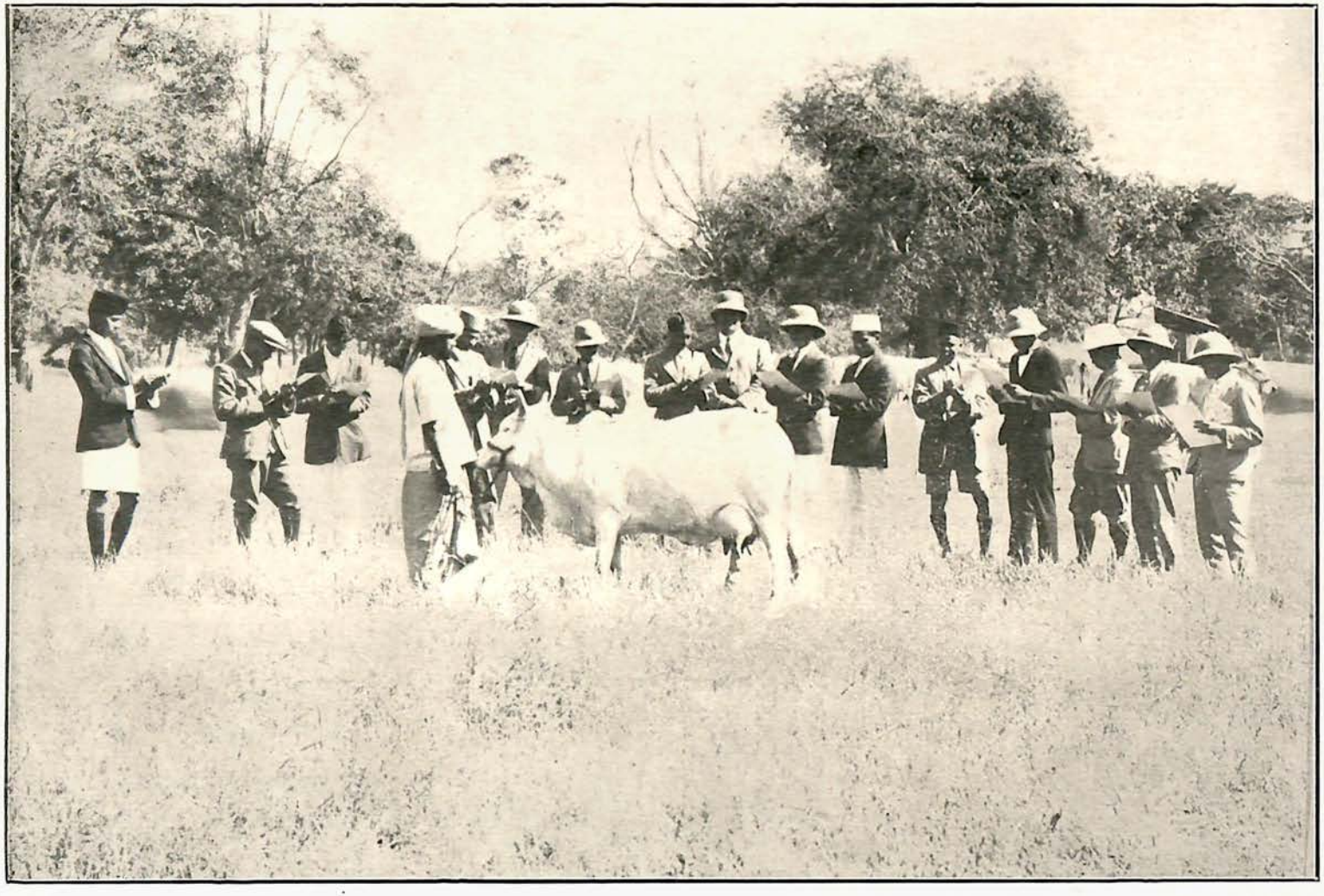
List of Agricultural Publications in India during 1923-24—contd.

No.	Title	Author	Where published
	VETERINARY—*contd.*		
170	Annual Report of the Civil Veterinary Department, Bihar and Orissa, for 1922-23. Price As. 12.	Issued by the Civil Veterinary Department, Bihar and Orissa.	Government Printing, Bihar and Orissa, Patna.
171	Annual Report of the Civil Veterinary Department, United Provinces, for the year ending 31st March, 1923. Price R. 1-2.	Issued by the Civil Veterinary Department, United Provinces.	Government Press, United Provinces, Allahabad.
172	Annual Report of the Punjab Veterinary College, Civil Veterinary Department, Punjab, and the Government Cattle Farm, Hissar, for the year 1922-23. Price R. 1-8.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
173	Annual Report of the Camel Specialist for 1922-23. Price As. 4.	Ditto	Ditto
174	Cattle Census Report, Punjab, for the quinquennium ending 1922. Price As. 8 or 8*d*.	Ditto	Ditto
175	Punjab Cattle Census of 1923. Price As. 8 or 8*d*.	Ditto	Ditto
176	List of Horse Shows and Cattle Fairs in the Punjab and Native States during 1923-24.	Ditto	Ditto
177	Recurrent Orchitis in Donkey Colts at Government Cattle Farm, Hissar. Punjab Veterinary Bulletin No. 4. (Reprinted.)	R. Branford, M.R.C.V.S., Superintendent, Government Cattle Farm, Hissar.	Ditto
178	Surra Transmission Experiments with *Tabanus albimedius* and Ticks. Punjab Veterinary Bulletin No. 12. (Reprinted.)	Captain H. E. Cross, M.R.C.V.S., Camel Specialist, Sohawa.	Ditto
179	Prospectus of the Punjab Veterinary College, Lahore.	Issued by the Department of Agriculture, Punjab.	Ditto
180	Syllabus of Lectures at Punjab Veterinary College.	Ditto	Ditto

List of Agricultural Publications in India during 1923-24—concld.

No.	Title	Author	Where published
	VETERINARY—*concld.*		
181	Fly Survey Report, Punjab	Captain H. E. Cross, M.R.C.V.S., Camel Specialist, Sohawa.	Government Printing, Punjab, Lahore.
182	Annual Administration Reports of the Bombay Veterinary College, Glanders and Farcy Department and Civil Veterinary Department, Bombay Presidency, for 1922-23. Price As. 5.	Issued by the Civil Veterinary Department, Bombay	Government Central Press, Bombay.
183	Annual Administration Report of the Civil Veterinary Department, Madras Presidency, for 1922-23.	Issued by the Civil Veterinary Department, Madras.	Government Press, Madras.
184	Black Quarter. Madras Civil Veterinary Department Leaflet No. 7.	D. A. D. Aitchison, M.R.C.V.S., Ag. Chief Superintendent, Civil Veterinary Department, Madras.	Ditto
185	Report on the Working of the Civil Veterinary Department, Central Provinces and Berar, for 1922-23. Price R. 1.	Issued by the Civil Veterinary Department, Central Provinces.	Government Press, Nagpur.
186	Report of the Civil Veterinary Department, Assam, for 1922-23. Price As. 8 or 9*d*.	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
187	Report of the Civil Veterinary Department (including the Insein Veterinary School), Burma, for the year ending 31st March, 1923. Price R. 1.	Issued by the Civil Veterinary Department, Burma.	Government Printing, Burma, Rangoon.
188	Report of the Civil Veterinary Department, North-West Frontier Province, for the year 1922 23. Price As. 13.	Issued by the Civil Veterinary Department, N.-W. F. Province.	Government Press, Peshawar.
189	Annual Report of the Mysore Civil Veterinary Department for 1922-23.	Issued by the Department of Agriculture, Mysore.	Government Press, Bangalore.
190	Annual Report of the Government Stud Farm, Kunigal, for 1922-23.	Issued by the Chief Commandant, Mysore State Troops.	Ditto

GIPC—L—IV-2-95—5-3-25—1,350.

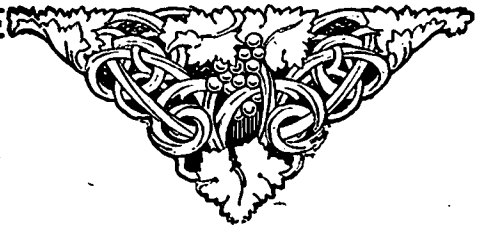


TEACHING STUDENTS ON KARNAL FARM HOW TO JUDGE STOCK.

PLATE VI.

Review of Agricultural Operations in India

1924-25



CALCUTTA: GOVERNMENT OF INDIA
CENTRAL PUBLICATION BRANCH
1926

PREFACE

A perusal of this report will give some idea of the wide range of the problems which the Imperial and Provincial Departments of Agriculture are tackling, and of the great variety of soil and climatic conditions under which these are being investigated. In no industry perhaps are the problems more complex: their number is almost overwhelming and the workers are few. The variety of problems and the paucity of qualified researchers are handicaps which make co-ordination and co-operation absolutely indispensable.

Progress in agricultural development must be based on new knowledge: there is only one way of wresting from Nature this knowledge and that is by scientific research. Our work in this direction is only beginning; we have as yet but touched the fringe of the problems awaiting solution. There is unfortunately a real danger in these days of the importance of scientific research being lost sight of and of development not being able to keep abreast of the demands upon it. What the department most urgently requires is the better organization of research throughout India and better facilities for training investigators. Thus and thus only can we supply the knowledge on which continuous improvement in every branch of agriculture must be based.

D. CLOUSTON,
Agricultural Adviser to the Government of India.

PUSA,
February 13th, 1926.

TABLE OF CONTENTS

	Page
Chapter I. Agricultural Conditions of the Year	1
Chapter II. Economic work on Crops—	
I. Rice	4
II. Wheat	8
III. Cotton	11
IV. Sugarcane	23
V. Jute	31
VI. Other fibres	33
VII. Tobacco	34
VIII. Oil-seeds—	
Linseed	37
Mustard	38
Castor	*ib.*
Sesamum	*ib.*
Groundnut	*ib.*
Coconut	39
IX. Tea	*ib.*
X. Coffee	40
XI. Rubber	41
XII. Fruit	42
XIII. Fodder crops and grasses	43
XIV. Juar (*Sorghum*)	46
XV. Ragi (*Eleusine coracana*)	47
XVI. Potatoes	48
XVII. Beans and pulses	49
Chapter III. Research and Investigation—	
I. Soils—	
Survey of soils	50
Soil acidity	51
Soil drainage	*ib.*
Soil moisture	*ib.*
Soil aeration	52
The " available " phosphoric acid in soil	*ib.*
Movements of nitrates	*ib.*

PAGE

II. Nitrogen fixation 52
III. Manures and fertilizers—
Organic manures 53
Phosphates 55
Calcium cyanamide . . . . . *ib.*
Gypsum 56
Lime . . . . . *ib.*
Influence of manures on quality of crops . . *ib.*
IV. Sugarcane 57
V. Sugar-beet . . . . . *ib.*
VI. Losses in sugar mills 58
VII. Animal nutrition . . . . . *ib.*
VIII. Milk . . . . . *ib.*
IX. Effect of grass on fruit trees 59
X. Water Hyacinth 60
XI. The Lavala Weed . . . . . *ib.*
XII. Diseases of crops 61
XIII. Insect pests 63
XIV. Useful insects—
(1) Bees 64
(2) Lac 65
(3) Silkworms . . . . . *ib.*

CHAPTER IV. AGRICULTURAL ENGINEERING—
(1) Bombay 67
(2) United Provinces 68
(3) Punjab . . . . . *ib.*
(4) Bihar and Orissa . . . . . *ib.*
(5) Central Provinces . . . . . *ib.*
(6) Burma . . . . . *ib.*
(7) Madras 69
(8) Mysore . . . . . *ib.*
(9) Travancore . . . . . *ib.*
(10) Hyderabad . . . . . *ib.*
(11) Motor tractors . . . . . *ib.*

CHAPTER V. DISTRICT WORK—
(1) Bombay 73
(2) Madras . . . . . *ib.*
(3) Bengal 74

PAGE

(4) Bihar and Orissa 74
(5) United Provinces 75
(6) Punjab . . . . . *ib.*
(7) Central Provinces 76
(8) Burma . . . . . *ib.*
(9) Assam . . . . . *ib.*
(10) North-West Frontier Province 77
(11) Mysore . . . . . *ib.*
(12) Travancore . . . . . *ib.*
(13) Baroda . . . . . *ib.*
(14) Hyderabad . . . . . *ib.*
(15) Kashmir . . . . . *ib.*

CHAPTER VI. AGRICULTURAL EDUCATION—

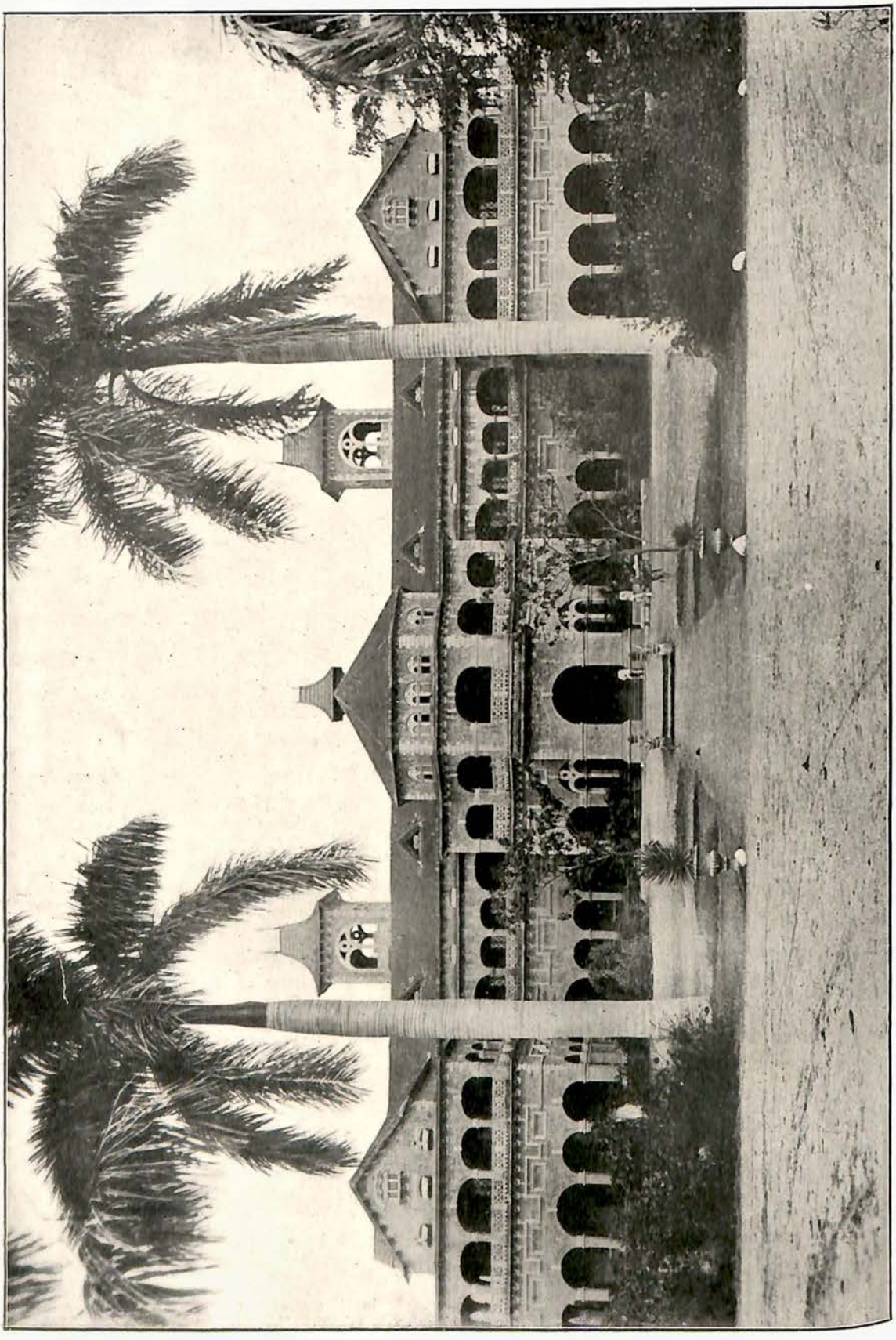
I. Higher Agricultural Education 78
(1) Poona . . . . . *ib.*
(2) Coimbatore 79
(3) Lyallpur . . . . . *ib.*
(4) Cawnpore . . . . . *ib.*
(5) Nagpur 80
(6) Mandalay . . . . . *ib.*
(7) Pusa . . . . . *ib.*
(8) Bangalore 81
II. Agricultural schools . . . . . *ib.*
III. Short courses 83

CHAPTER VII. THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE—

(1) Bombay 85
(2) Madras 86
(3) Bengal . . . . . *ib.*
(4) Bihar and Orissa 87
(5) United Provinces . . . . . *ib.*
(6) Punjab . . . . . *ib.*
(7) Central Provinces 88
(8) Burma . . . . . *ib.*
(9) Assam . . . . . *ib.*
Co-operative cotton sale societies . . . . *ib.*
Co-operative milk societies 89
Cattle insurance . . . . . *ib.*

		Page
Chapter VIII. Live Stock—		
	I. Prevention and treatment of disease . . .	91
	II. Incidence of disease	92
	III. Preventive inoculation	94
	IV. Veterinary education	96
	V. Veterinary research	97
	VI. Breeding—	
	(1) Cattle-breeding	99
	(2) Sheep-breeding	106
Chapter IX. Publications of the Agricultural Departments—		
	(1) Imperial	108
	(2) Provincial	*ib.*
Chapter X. Receipts and Expenditure of the Agricultural Departments		110
Appendix	I. Areas under new and improved varieties of crops during the year 1924-25 . .	113
,,	II. List of Agricultural Stations in British India in 1924-25	117
,,	III. Table showing results of well-boring during 1924-25	128
,,	IV. Table showing the number of improved implements sold through departmental agency during 1924-25	129
,,	V. List of Agricultural Colleges and Schools in British India in 1924-25 .	130
,,	VI. Operations of Non-Credit Agricultural Co-operative Societies in British India during 1924-25	135
,,	VII. Table showing the working of the Provincial Civil Veterinary Departments during 1924-25	139
,,	VIII. Table showing details as to students of Veterinary Colleges and Schools in India during 1924-25	140
,,	IX. Table showing the number of cattle issued from Government farms during 1924-25	141
,,	X. List of Agricultural Publications in India during 1924-25	142

PLATE 1.



THE AGRICULTURAL COLLEGE, NAGPUR.

Review of Agricultural Operations in India 1924-25

CHAPTER I.

AGRICULTURAL CONDITIONS OF THE YEAR.

The Arabian Sea monsoon of 1924 was late in establishing itself, particularly in North-West India, but the total rainfall during the season was slightly above the normal. A heavy downpour in July produced unprecedented floods in the rivers of the West Coast, which seriously damaged communications, washed away houses, crops and fodder stacks and silted up thousands of acres of cultivated land in the affected portions of Malabar, Trichinopoly and Tanjore. A similar calamity occurred in September in districts of the Punjab and the United Provinces on the upper reaches of the Ganges and the Jumna. Owing to the prolongation of the South-West monsoon conditions in the Bay and the weak incidence generally of the North-East monsoon, the rainfall during the period October to December was below the normal in the south of the Peninsula. The winter rains were unusually heavy in the United Provinces, the Punjab and Rajputana. Taking the year as a whole, the rainfall was roughly normal or in excess over the plains of India, considerable shortage having occurred only in Orissa and North Hyderabad. The season can be described as having been fairly good; almost all the important crops gave normal outturns.

The prices of farm produce having kept pace with the cost of other necessaries of life, the economic position of the agriculturist was satisfactory throughout the year. There was no lack of employment for agricultural labourers; they were able therefore to command good wages.

The year was not, however, so good for live stock. In several provinces, rinderpest broke out in a virulent form and the reported mortality was higher than in the preceding year. Except in districts which suffered from floods, the fodder supply was normal.

CHAPTER II.

ECONOMIC WORK ON CROPS.

To the ordinary Indian agriculturist, a man of small means who cannot afford to dabble in experiments, the question of the suitability of crops to local conditions becomes a matter of paramount importance. For this reason, the Agricultural Department from the very beginning took up the study of the numerous varieties of the staple crops cultivated in the country.

These were found to be mixed to an extraordinary degree. The separation of the mixtures into their component parts yielded frequently types quite suitable for different soil and climatic conditions. In other cases hybridization was resorted to, and entirely new strains were evolved. The new types of canes evolved at Coimbatore and now being tested in every cane-growing tract in India owe their origin, for example, to the ingenuity of a plant-breeder—Dr. Barber—who discovered that cane seed produced at Coimbatore was fertile, and that it was therefore possible to breed an unlimited number of new varieties in that part of India. The Indian peasant with a sagacity characteristic of him, is not slow to recognize a good thing when he sees it, especially when its adoption does not mean any material increase in the expenditure he is in the habit of incurring. When he realized that greatly improved races of his staple crops were forthcoming, he did not fail to take advantage of that knowledge, with the result that to-day they are being grown literally on millions of acres throughout India (Appendix I, p. 113). Though the present area under improved crops is only a small proportion of the whole cultivated area, the rapid pace at which progress is being made will be apparent from the following statement :—

Crop	1923-24 Acres	1924-25 Acres
Cotton	2,348,882	3,011,447
Wheat	1,990,326 (revised)	2,282,120
Rice	603,603	569,908
Jute	210,262	299,520
Sugarcane	50,604	75,334
Other crops	467,146	521,970
TOTAL	5,670,823	6,760,299

If Rs. 10 per acre be taken as the additional profit made from the adoption of these varieties, it is estimated that the annual value of the agricultural crops of the country has been enhanced by nearly seven crores of rupees, of which one crore has been added in a single year. How conservative this estimate is, will be apparent from the fact that the Director of Agriculture, Punjab, calculates that in the Punjab alone the introduction of improved varieties of wheat and cotton has been the means of adding five crores of rupees to the farming profits of the cultivators. English planters in Bihar who are growing the new varieties of Coimbatore (Co.) canes already referred to have, they say, increased their acreage profits on cane cultivation by 100 per cent. in many cases. Their extra profit seldom or never falls below 50 per cent.

In some cases the improved variety has replaced much less profitable crops. In the Bombay Presidency, for example, an improved variety of groundnut which brings in from Rs. 80 to Rs. 100 per acre has taken the place of other crops worth about Rs. 40 only: while in Bihar and Orissa a variety of the same crop has been introduced which gives a yield worth Rs. 100 per acre, on light soil on which the cultivators formerly grew *kurthi*, the value of which never exceeded Rs. 16 per acre.

I. Rice.

Of all the crops grown in India, rice stands an easy first in importance. On an average, 35 per cent. of the total cultivated area of India is under rice; in Assam the area is nearly 80 per cent., in Burma 74 per cent., and in Bengal 70 per cent. This huge area not only provides the staple food of most of the people of the country, but it also enables India to maintain its position as the largest exporter of rice in the world. It is the only known crop which could be grown without an elaborate system of drainage over millions of acres; a heavy and well-distributed rainfall naturally results in an increase of the area sown as well as of the crop harvested. The total acreage of

81,328,000 during the year under report was higher than that of the previous year by 2 per cent.; the estimated yield of 31,097,000 tons represented an increase of 10 per cent.

With nearly 21 million acres, or 26 per cent. of the total acreage under the crop, BENGAL is the most important rice-growing province in India. Their plant-breeders have devoted much time and patience to the selection of varieties suitable for different soil and climatic conditions, and in this they have achieved a measure of success. In Indrasail and Dudshar the department has two transplanted *amans* which are suited for heavy and light soils respectively, in Northern and Eastern Bengal. The broadcast *aus* group is represented by Kataktara and Surajmukhi which do extremely well on fertile high land in rotation with a *rabi* crop, and by a very fine, early-ripening rice called Charnak which is recommended for lighter soils. In localities suited to them, the selections have earned the reputation of yielding at least 240 lb. per acre more than the *desi* mixtures usually grown. During the year under report, they were estimated to have been grown on an area of 120,819 acres.

How to produce strains which will mature early enough to eliminate danger from an early cessation of rains, a frequent occurrence in West Bengal, is a problem which is being attacked by crossing early and late *aus* and *aus* and *aman* varieties. In both series very promising strains have been isolated which are being grown this year for a critical test at Bankura and Suri. Progress is also reported in the selection of some of the principal *balam* and deep-water rices. The former do not flourish outside their home in Barisal; but with respect to yield and fineness are probably unsurpassed in Bengal.

That the grains of highland *aus* are sufficiently mature to be capable of attaining optimum germination 20 days after flowering, has been confirmed in further tests this year. In the case of *aman* rice, the period from flowering to maturity appears to be longer by about a week. The importance of this work lies in that it may be possible to harvest the crop much earlier than is ordinarily done—at any rate for seed purposes.

The rice investigations in MADRAS comprise the raising and testing of improved types, the study of inheritance of characters, and the crossing of different strains. As a result of many years of patient work at Coimbatore and Aduturai, several superior varieties have been isolated, tested and propagated for distribution. They are G. E. B. No. 24, Coimbatore Nos. 1 and 2, and Aduturai Nos. 1, 2, 3, 4 and 5. During the year under report, three new strains were given out for general cultivation, *viz.*, Coimbatore No. 3 which has given, in a five-year test, an average increase of 9 per cent., and Red and White Ottadan (Aduturai Nos. 6 and 7) which have given 13 per cent. over the *desi* varieties grown.

An investigation into the cause of rice failing to set grain has been started at Coimbatore. The results obtained from the cross Sirumani × Anaikomban appear to indicate that there is some correlation between this peculiar feature and the colour of the glume. A detailed study of the problem of lodging has also been put in hand.

Manurial trials at Samalkota indicate that bonemeal used in conjunction with green leaf is a profitable investment on the poor rice lands of the Godavari delta.

Rice-breeding work in BURMA is concentrated at Mandalay and Hmawbi. At the former station, the aim is to produce superior varieties suitable for irrigated tracts which will replace the older selections, T. Ngasein and T. Taungdeikpan. At Hmawbi, an effort is being made to isolate earlier rain-fed varieties than the now widely cultivated Ngasein 8 and Ngasein 10. Hundreds of pure local strains, exotics and hybrids are under observation; of these, one very promising known as Ngasein C. 19-26 from Hmawbi has been given out for large-scale trials in selected localities.

Seed-rate experiments at both the rice stations have conclusively proved that a better yield per acre can be obtained by using only one-third to one-half the quantity of seed generally sown by the cultivator.

Dahia paddy continues to maintain in BIHAR AND ORISSA its reputation for producing on poor land, liable to drought,

a greater weight of rice of good quality than any other variety known in the province. Its estimated outturn last year in the Bhagalpur Circle alone was 4,000 tons. The excellence of its quality can be gauged from the fact that one rice mill in Bhagalpur is buying this paddy only, and is paying a premium for it. Selections Nos. I and III from Kakharua have become very popular in Cuttack and Puri Districts. In rice tests begun at Sepaya, the Dacca Kataktara again proved a most suitable *aus* for high-lying tracts.

Phosphate applied to rice land in South Bhagalpur along with a green manure gave a net profit of Rs. 15 to Rs. 30 per acre.

The rices selected in ASSAM for their high yielding capacity are the *sail* varieties Georgesail, Latisail and Indrasail; the *aus* Kataktara and the *asra* Birpak. On departmental farms as well as in cultivators' fields, these selections yield up to 600 lb. more than the local varieties.

On the Adhartal farm in the CENTRAL PROVINCES a rice has been obtained which matures in 69 days and yields without irrigation about 800 lb. of grain per acre. This variety should be valuable for parts of the Northern Circle where the critical period of the monsoon is the end of August. Selection work at Labhandi has discovered a dark-skinned rice of high yielding power. It will be of special value to cultivators in Chhattisgarh Division who practice the *biasi* (broadcast) system of growing rice, as its coloured stem distinguishes it from the wild rices which grow as a weed in their paddy fields. Varieties of rice selected by the department were grown on an area of 118,865 acres during the year under report.

Rice-breeding work at Karjat in the BOMBAY PRESIDENCY has yielded a pure strain of Kolamba, No. 42, which gives an increased outturn of 20 per cent. over the local mixture. The acreage under this strain already exceeds 10,000 acres in the North Konkan, where it has given an increased return worth Rs. 12 per acre.

From a collection of 1,200 rices made at Cawnpore in the UNITED PROVINCES, 163 pure strains have been selected for

further study. Some of these have been given out to selected growers for trial under local conditions.

The local Hallubbalu and Coimbatore No. 1 are the two short-season paddies selected for distribution in MYSORE.

In the TRAVANCORE STATE, experiments designed to find out early varieties and suitable manures, to reduce the seed-rate and to improve the cultural operations are in progress.

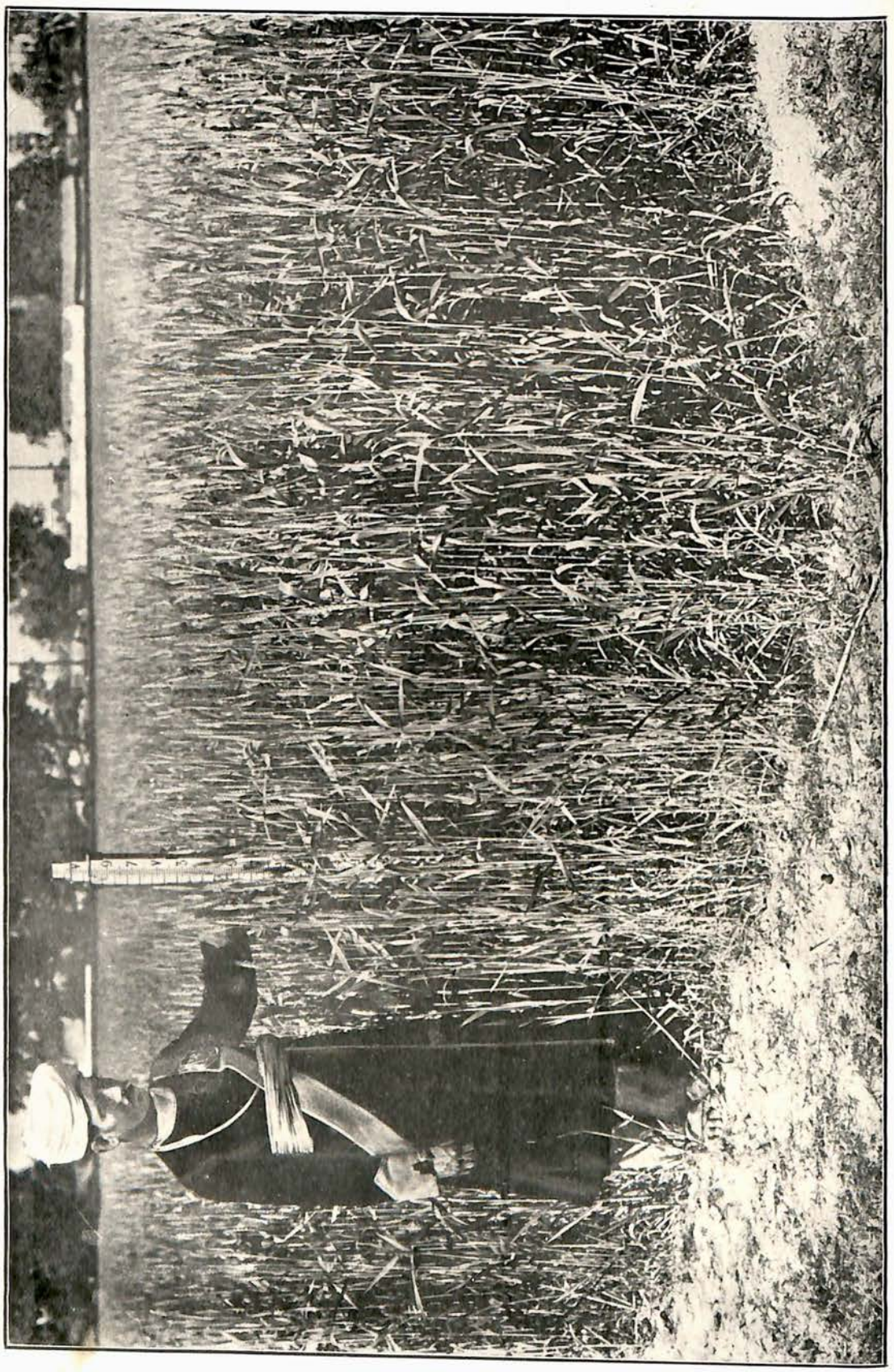
Initial results with the Karjat selection of Kolamba rice have proved very encouraging in the Navasari District of the BARODA STATE.

II. Wheat.

In area wheat stands next to rice. It is the main food staple of the people of Upper India, and is grown on about 10 per cent. of the total cultivated area of the country. The area of 31,788,000 acres sown during the year represented an increase of 2 per cent. over the previous year; but unfavourable climatic conditions during the time of ripening and harvesting, in the two principal wheat-growing provinces (the Punjab and the United Provinces), reduced the estimated yield per acre by 81 lb., with the result that the total outturn of 8,702,000 tons was 10 per cent. below the figure of the previous year.

The replacement of the country wheats by higher yielding varieties of better grain quality is proceeding apace. The new Pusa varieties not only combine high yield, good milling and baking qualities, strong straw and resistance to rust, but possess the added character of being able to mature with less water than the general run of Indian wheats. During the year under report they occupied an area of 2,282,120 acres, which was higher than that of the previous year by nearly 15 per cent. Their reputation has also spread to other countries, and there is now a demand for seed of Pusa wheats from countries as wide apart as Rhodesia, New South Wales and Ukraine. Introduced into Queensland fifteen years ago, there was a fairly general sowing of Pusa 4 under rather varying conditions this year. In this connection the Journal of the local department writes :—" On the slopes and higher lands Pusa wheat exceeded

PLATE II.



A FIELD OF PUSA 52 WHEAT AT PUSA.

expectations and proved its capacity to yield heavily, twelve and up to fourteen bag crops being not uncommon, with an occasional yield of fifteen bags per acre. This variety, clean this year, is somewhat liable to rust in wet seasons, but notwithstanding this drawback gave thirteen and fourteen bags to the acre last year when rust was prevalent. One feature can always be relied upon with Pusa—it will fill and hold its grain and produce a plump, fairly bright sample even when badly rusted and subjected to a lot of wet weather at harvest time, and may be regarded as superior in these respects to any other variety at present in cultivation in the State."

The two Pusa varieties (Pusa 4 and Pusa 12) which have an established position in the agriculture of Northern India, though superior to indigenous wheats in most essential characters, both lack the awn which is an asset of considerable importance in certain parts of the country as a protection against birds. There is a distinct demand for a bearded wheat with high yielding qualities. To meet this demand a series of bearded varieties has been fixed by hybridization between Pusa 6 and Punjab 9. Of these, Pusa 52 has emerged successfully from large-scale field trials. During the past season it gave 9,476 lb. of grain over an area of 4·22 acres, or roughly 37½ bushels per acre. Once it is known to the public, it will assuredly replace the older selections, especially in areas liable to damage by birds and animals.

The PUNJAB is the premier wheat-growing province in India, the area of 10,924,000 acres under wheat in that province being 34·1 per cent. of the total acreage under the crop in the whole of India. It is estimated that over 10 per cent. of this large area was sown last year with improved wheats. Of these, Punjab 11, having been the first in the field, is now the best known. It occupied 899,129 acres, and the more recent selection 8A 257,995 acres. The latter's superiority both in quantity and quality of grain and straw has now been demonstrated to the complete satisfaction of the cultivators, and it is gradually replacing Punjab 11 in certain tracts. On a 100-acre plot at the Imperial Cattle Farm at Karnal, Punjab 8A averaged 24½ maunds or 2,010 lb. per acre

in a year of low yields as was the year under report. Pusa 12 is popular in villages near Ferozepore and Panipat where wheat is irrigated from wells, while Pusa 4 is appreciated for cultivation on low-lying riverain lands.

Pusa 12, Pusa 4 and Cawnpore 13 wheats have received such wide recognition in the UNITED PROVINCES which carries 23·6 per cent. of the wheat area, that the energies of the department are mainly concentrated on maintaining a supply of pure seed. To meet the insistent demand for seed ten new central stores were opened during the year, and a proposal is afoot to construct nine more. The 98 stores at work during the year earned a profit of Rs. 13,086, or a return of 6 per cent. on the total investment, which shows that the ryots are willing to pay for seed the value of which they appreciate.

In the short space of ten years from the date of its first being tried in the NORTH-WEST FRONTIER PROVINCE, Pusa 4 has spread to nearly 25 per cent. of the total area under wheat. If the new bearded Pusa variety under trial at Tarnab is found to be as good as Pusa 4 in other characters, it will be more acceptable in a country where clouds of sparrows descending on fields when they are just ripening, do much damage to beardless varieties.

The cultivation of Pusa 4 and Pusa 12 is being encouraged in the Patna and Saran Districts of BIHAR. In a variety trial at Sepaya, Pusa 4 not only gave the highest yield, but its vigour and earliness were conspicuous throughout its whole period of growth. To quote the Deputy Director of Agriculture, "It is a fortnight in front of the next variety, and this is a most important consideration in an area where early west winds sometimes cause much damage to the ripening grain by hastening the maturation process."

Selection work on wheat in BURMA has been concentrated at Padu. In the Shan States, Federation and Pusa 4 continue to maintain their superiority over the local wheat.

In the CENTRAL PROVINCES, Pusa 100, Hoshangabad White Pissi; the departmental selection A089, and the A112, A113 and A115 hybrids have become the standard wheats for different

localities to which they are suited. The total area under these higher yielding strains is estimated to be 104,232 acres.

In BOMBAY, Pusa 12 and Punjab 11 have proved particularly suitable for Upper and South Sind respectively. The area under the former has increased from 5,000 to 14,000 acres in one year. Pusa 4 is making rapid progress in North Gujarat and the contiguous districts of the Baroda State, where it gives an increased yield of 200 lb. per acre and fetches a premium over the local Wajia.

III. Cotton.

During the year under review, the area under this crop rose to 26,465,000 acres with a yield of 6,072,000 bales as against 23,636,000 acres and 5,162,000 bales in the previous year. The average yield per acre was 92 lb. as compared with 87 lb. and 93 lb. in the two preceding years. The quantity of raw cotton exported during the year ending 31st March, 1925, was 3,326,000 bales of 400 lb. as compared with 3,764,000 bales in the previous year. Indian cotton consumed by Indian mills was estimated at 2,050,891 bales, as against 1,798,215 bales in the previous year. The value of cotton goods exported was Rs. 11,27 lakhs.

The final figure of the American crop of 1924 was 13,627,936 bales of 500 lb.; the final estimate of the area planted was raised to 42,641,000 acres, as against the first estimate of 40,403,000 acres. For the 1925 crop the first estimate of area was 46,448,000 acres which constituted a new record; the yield was estimated at over 15½ million bales. Hence the world's cotton supply is in a more satisfactory position than for many years. Nevertheless the demand for Indian cotton has continued to be satisfactory, and the stocks in Bombay at the end of the season 1924-25 (August 31st) were less than at the same time in the previous year. Good prices and on the whole a favourable early monsoon led to large sowings in India in 1925, the area recorded in the second forecast being 22,752,000 acres, as compared with 21,785,000 acres in 1924.

THE INDIAN CENTRAL COTTON COMMITTEE has now completed its fourth year since its constitution as an advisory body and its second year since its incorporation under the Indian Cotton Cess Act, 1923. The Committee has continued to devote attention to the improvement of marketing, the prevention of malpractices and to the general interests of the cotton industry. The passing of the *Cotton Ginning and Pressing Factories Act*, a measure which had been under consideration since 1921, and the necessity of which was pointed out by the original Indian Cotton Committee of 1917-18, is undoubtedly an outstanding event of the year. The Act came into force throughout India at the beginning of the 1925-26 cotton season, and from that date it has been compulsory on all press-owners to mark every bale of cotton pressed with the special mark of the press, the year and the running number of the bale, and to maintain records of the ownership of all cotton pressed. Similarly ginning factories are required to maintain records of all cotton ginned and of its ownership. The Act provides for certain minimum structural requirements being observed by all new ginning factories, and within a fixed period from the passing of the Act all press-houses must be properly paved or floored. In addition, weekly returns of cotton pressed throughout British India are now compulsory except in Burma and are being regularly published, thus providing most valuable statistical information to the trade.

The Cotton Transport Act has continued to work well in the areas to which it has been applied in the Bombay Presidency. During the year the Madras Government announced its intention of putting the Act into force for the protection of three zones, *viz.*, the Tiruppur Cambodia, Northerns and Westerns, and Tinnevelly zones respectively, in that presidency. The necessary notification has since been approved and a resolution to that effect passed by the Provincial Legislative Council. It will thus be seen that the protection of the Act has now been extended to most of the important long staple cotton tracts of British India. It is also very satisfactory to be able to record that the Baroda and Rajpipla States have passed similar legis-

lation of their own, thus automatically securing for the zones notified the protection of the British India Act.

Attempts have also been made to obtain the co-operation of the Indian States in regard to the Cotton Ginning and Pressing Factories Act, particularly in respect to the marking of bales, and it is satisfactory to be able to record that the Baroda State has intimated its intention of passing the necessary legislation at the earliest possible date. In regard to many of the States the question is still under consideration; but it is known that certain States in Central India and Rajputana have already taken steps to secure the proper marking of bales at the cotton pressing factories within their respective boundaries.

During the year the Committee completed its investigation into the question of the *fumigation of American cotton to prevent the introduction of the boll-weevil.* In most years there are small imports of American cotton into India for special purposes; in occasional years such imports are of considerable magnitude. Since the close of the year the necessary notification under the Destructive Insects and Pests Act has been issued by the Government of India, and henceforth American cotton will be allowed to enter India only at Bombay and then only after proper fumigation.

In connection with its work for the *improvement of cotton marketing* the Committee has undertaken an enquiry into the finance of the cotton crop up-country. Replies to the preliminary questionnaire have been received from all parts of India and special local investigations have been arranged for in three tracts in the first instance. The investigation is a difficult one and will take some time to complete. On its importance it is unnecessary to dwell, since at present there is a regrettable lack of information as to the extent to which the cultivator is hampered in his efforts to obtain full value for his produce by lack of financial facilities, and as to what extent his difficulties are mainly due to actual lack of suitable market organization.

Marketing of improved cottons. In last year's report a reference was made to the spinning trials which had been arranged with the Oldham Master Cotton Spinners' and Manu-

facturers' Associations. The reports on those trials were of very considerable value as demonstrating clearly that certain of the newer Indian cottons are fully capable of replacing certain types of American cotton under normal Lancashire spinning conditions. A further extension of these spinning trials has been arranged on five-bale lots supplied from the 1924-25 crop, as it is considered that the information thus provided as to the relative value of these cottons as compared with American should be of very great use. In order to facilitate export sales of such cottons the Central Cotton Committee has arranged to provide type bales described under the Agricultural Departments' varietal names for certain important Cotton Exchanges, so that both spinners and merchants can obtain reliable samples of these cottons on which commercial types can be based. The Liverpool, Manchester and East India Cotton Associations have kindly undertaken to co-operate with the Committee in this matter.

The Committee is able to record very definite progress in regard to its research schemes. In December 1924, His Excellency the Viceroy formally opened the *Spinning Laboratory* and laid the foundation-stone of the main building for the *Technological Research Laboratory* at Matunga. Since then the Research Laboratory has been completed and equipped. Very substantial additions have been made to the staff of both the Spinning Laboratory Testing Room and the Research Laboratory; of these the scientific staff, apart from the actual Spinning Room staff, now numbers 19.

The routine for spinning tests on small samples of cotton has been fully developed, and it has been definitely shown by comparative tests on standard cottons that satisfactory spinning tests can be carried out on five-pound samples which, allowing for the necessary duplication and for the supply of cotton required for tests on fibre, means that a cotton-breeder can now obtain a full report on a 12 lb. sample of cotton. The Yarn Testing Room has been fully organized and the yarns produced are now critically examined so that the spinning report is of very definite practical value. Reports on fibre characters to

Agricultural Departments have so far been limited to statements of staple length, distribution and diameter.

Agricultural Departments have availed themselves very fully of the new facilities provided, and the Spinning Laboratory has been fully occupied throughout the year. The number of samples received from Agricultural Departments for testing up to March 1925, was 63; it is clear that the facilities provided by the Committee are appreciated.

In the Research Laboratory a study has been made of certain of the measurable characters of the cotton fibre and their bearing on spinning value. The ultimate object of this work is to provide the cotton-breeder with more definite information as to which fibre characters are commercially important. The field is a new one and as both the designing of new methods and the correlation of laboratory results with spinning tests are involved, the value of the data accumulated will increase steadily year by year.

In connection with the spinning tests on the standard Indian cottons, which term includes mainly those new varieties which Agricultural Departments have now introduced on a commercial scale, a beginning has been made on the study of the seasonal variation in the spinning quality of certain cottons. It is generally believed that although many of the fibre characters of cotton are hereditary they can be modified by environment; but until the Technological Laboratory was started no means existed for testing this belief, or of ascertaining the importance to be attached to environmental conditions.

The Institute of Plant Industry at Indore, for which the Indian Central Cotton Committee provides the bulk of the funds, is now in full working order. During the year under report the Governing Body met, plans and estimates for the buildings and a grant for equipment were passed, and work was started at once. The buildings and equipment have since been completed and the first year's cotton experiments carried through. Though much remains to be done in laying out the Institute's farm and in building up the staff, very definite progress has been made. The speed with which the equipment of

the Institute has been completed is a tribute both to the energy of the Director and the staff, and to the very generous assistance which the Governors and Director have received from the officials of the Central India Agency and of the Indore State.

The special Cotton Botanist provided by the Committee for the Punjab was appointed during the year and took up his duties during the cotton season of 1925. Mr. Trought, the officer appointed, was previously the Senior Botanist to the Egyptian Ministry of Agriculture (Cotton Research Board), and brings to his work both long experience in cotton investigations and a knowledge of cotton-growing under irrigation conditions.

Satisfactory progress was made with the Committee's four *research schemes* in the Bombay Presidency on the *Earias* bollworm, cotton wilt, the physiology of the cotton plant at Surat and the improvement of Dharwar-Upland cottons by hybridization. Very detailed reports were submitted to the Committee on work done during the period 1923 to 1925, and there is every indication that practical results of value will be achieved. Satisfactory progress was also made with the Madras research scheme on the study of the *herbaceum* cottons of that presidency. During the year an interesting progress report was laid before the Committee on the work done at Cawnpore on the pink bollworm research scheme in which quantitative information was given of the loss, both in yield and quality, caused by this pest and in which definite suggestions were made as to the lines on which control could be established. Considerable progress was made in connection with the Committee's research scheme in the Central Provinces on the improvement of the Oomras type of cotton and on cotton wilt disease. In regard to the former it is only possible to say at present that the work has been carried out on satisfactory lines, and that it must necessarily be some time before definite results can be expected, although some of the new strains of cotton obtained are of considerable promise.

During the year the Committee completed a report on the present position of cotton investigations in India and developed

from this a programme of future work. Of the new research schemes sanctioned by the Committee, the Coimbatore scheme for an investigation into the loss of crop by bud, flower and boll shedding, and comprising also botanical and bio-chemical investigations in connection with the stem weevil (*Pempheres*) and the production of resistant types of cotton, has been accepted by the Madras Government, and steps are being taken to obtain the necessary staff.

The Government of Bombay have also accepted the Committee's offer to make a grant for certain special investigations in connection with the growing of long stapled cotton in Sind. Details are necessarily awaiting the Local Government's own general scheme for agricultural research in connection with the Sukkur Barrage canal scheme. The latter has now been sanctioned and it is understood that work will commence at an early date.

Work for the improvement of cotton-growing in the various provinces has continued on the lines already established. The BOMBAY PRESIDENCY with an area of over 5 million acres consists of five distinct cotton-growing tracts, of which four are in the presidency proper and one in Sind. In Sind acclimatized American cotton is spreading rapidly on the Jamrao canal area, despite the inadequate water supply. The area in 1924 was reported to be 20,000 acres which under existing conditions is nearing the average limit for this type of cotton; but the whole position of cotton-growing in Sind will be revolutionized on the completion of the Sukkur Barrage canal system. At present the American cotton under cultivation in Sind is Punjab-American 4F. and Punjab-American 285F.

The important work in South Gujarat, where one type of superior staple gradually is being pushed throughout the whole of the area south of the Narbada, has been continued. The selection known as No. 1027 has been shown to be suitable for the whole of this tract and is rapidly spreading throughout the Surat District, the southern part of the Broach District and the corresponding portion of the Baroda State; whilst the Rajpipla State now grows no other cotton. It is estimated that the replacement of the previous mixed types by this pure strain

represents an additional income of Rs. 30 lakhs annually to this tract. For the Broach area of Northern Gujarat a suitable improved type (which is a hybrid combining good staple with a high ginning percentage) has now been evolved at the Surat farm, and its introduction for large scale testing is now well under way. In the Dholleras area a good strain of the Wagad type, which is the most valuable constituent of that cotton, has been evolved, and the question of its multiplication and introduction has now been taken up.

In the southern part of the presidency, which grows the Kumpta (*herbaceum*) type and the Dharwar (Upland) type, the spread of the two improved strains known as Dharwar No. 1 and Gadag No. 1, respectively, has been rapidly developed mainly through the co-operation of the co-operative cotton sale societies. Those societies have not only organized the sale of *kapas* of these superior varieties, thus securing to the grower the real market value, but have undertaken the organization of the seed supply to a considerable extent. In the Southern Division, as in Gujarat, success has been achieved by the Agricultural Department controlling considerable areas for the production of seed. During the year under report, certified seed for about one lakh of acres of each variety was issued, so that the complete replacement of existing mixtures by two pure strains is now within sight. In the Kumpta cotton area two important problems have still to be faced. In the first place the selected Kumpta types so far obtained are satisfactory in staple but are low in ginning percentage. Work on hybrids between the Kumpta and Roseum types has enabled a strain to be isolated which while possessing the length of the staple of Kumpta has a better ginning percentage and a whiter colour. This is now being multiplied for introduction in the area around Gokak for which it is believed to be particularly suitable. Another great difficulty has been the loss caused by the cotton wilt disease in the Dharwar District where it is believed to be spreading. Kumpta cotton types with a high degree of immunity have now been obtained which, it is hoped, will provide a palliative if not a solution of the wilt problem.

In Khandesh, pending the isolation of a better type, the distribution of a pure strain of Roseum cotton has been continued through co-operative societies and Taluqa Development Associations. The hybrids between Bani (*G. indicum*) and Comilla (*G. cernuum*) referred to in last year's report have continued to show promise and seem likely to provide Khandesh in the near future with a cotton equal in yield and ginning percentage to the local variety but with a much better lint.

In MADRAS, work on the improvement of Cambodia, Tinnevellys, Northerns and Westerns cottons has been continued. The area under irrigated Cambodia rose to 248,000 acres with a crop of 142,000 bales which is the highest on record. There was also an increase in the unirrigated crop, the total area under Cambodia cotton being 440,000 acres and the estimated yield 179,000 bales.

The replacement of the ordinary Tinnevelly type by Karunganni was continued. The area under Hagari 25, the improved type of Westerns cotton, is estimated to have risen to 180,000 acres from 81,000 acres in the previous year. The acreage under the improved type of Northerns, No. 14, is now supposed to be about 20,000 acres.

Comparative tests were continued with the various strains of Cambodia cotton isolated at the Coimbatore Research Station; the strain previously known as Cambodia 295 has now been issued on a field scale in the Avanashi tract near Tiruppur. Another strain, Cambodia 440, is of interest as being apparently much less susceptible to stem weevil damage than other strains. The new method of seed farm organization referred to in last year's report has been continued with apparently satisfactory results, thus enabling the department to control a larger supply of seed and to hasten the replacement of inferior by superior types.

The Madras Pest Act has been amended and some of the difficulties stated in last year's report have been removed, as the improved procedure now permits of much prompter action being taken to secure the removal of the old crop. Though the date fixed for such removal is still considerably later than that

advised by the Agricultural Department, there is every reason to believe that much smoother working will now be possible.

The total area under cotton in the PUNJAB (excluding the Indian States) was estimated in 1925 at 2,273,000 acres, as compared with 1,781,353 acres in 1924. The area under Punjab-American for the season 1924-25 was 934,000 acres with a yield of 355,000 bales, an increase of 50 per cent. on the previous season. The estimated acreage for the current season 1925-26 shows a further advance, being practically one million acres.

The bulk of the Punjab-American is of the 4F. type, but the 285F. selection which has a better staple has made considerable progress in certain tracts. A still later strain, 289F., which has hardly got beyond the experimental stage, is now grown on 2,000 acres. The practice of mixing *desi* cotton with 4F. and 4F. with 285F. has led to a most disastrous lowering of general prices, although individual large growers, whose produce commands confidence, are still obtaining satisfactory rates. It is hoped that recent legislation (the Cotton Ginning and Pressing Factories Act) will enable this abuse to be dealt with; but if this hope is not realized it is clear that more drastic steps will be necessary.

Pending the arrival of the new Cotton Research Botanist provided by the Indian Central Cotton Committee, experimental work on cotton continued mainly on previous lines. The improved strain of *desi* cotton, known as Mollisoni, continued to gain popularity in those parts of the canal colonies where a *desi* cotton is required, and some progress was made in the south-east of the province in the introduction of higher yielding types of the local cottons. The provision of a special Botanist will enable the many problems connected with long-staple cotton growing under canal colony conditions to be more fully investigated than has been possible in the past.

The distribution of Roseum cotton seed has been continued and the Agricultural Department's seed union organization extended in the CENTRAL PROVINCES. The introduction of superior types, whether in regard to wilt resistance or lint quality, awaits the results of research work now in progress.

A thorough botanical study of the various cottons of the province is now in hand, and some promising strains have been obtained all of which require further testing. The possibilities of the Plateau district for cotton produce have received attention and various types have been tested for suitability. Work on the Chanda Jari crop has been continued; this is a cold weather cotton which is believed to be a physiological race of Bani (*G. indicum*).

The area under the new variety Aligarh 19 sown in the UNITED PROVINCES in the 1925 season was only 5,000 acres. Reports on the examinations of cotton at the Central Cotton Committee's Technological Laboratory show that the lint is definitely superior to the Aligarh White Flower variety, which it will replace, though the new variety is suitable only for comparatively low counts.

In the Central Circle the extension of the J. N. 1 variety is being taken up. This is a variety possessing fairly good spinning qualities combined with a ginning percentage somewhat above the average. Of Dr. Leake's hybrid cottons, several have been further studied and definite strains isolated; one of these, E. 402 was found at the Technological Laboratory to be suitable for twist yarn up to 22 counts which, with a ginning percentage of 38-40, is exceedingly promising; further field trials of this strain are being conducted. Reference has already been made to the pink boll-worm research scheme which is partly financed by the Central Cotton Committee. It is estimated that the economic saving which would result from the proper control of this pest might amount to anything from 20 to 66 per cent. of the present value of the crop. It is almost established that by heat treatment of seed alone such control can be achieved. Experiments have been carried out this year in an isolated area of some 300 acres in order to test these conclusions.

The acreage under cotton in the United Provinces in 1924 and 1925 sowings was 1,032,000 and 636,000 acres respectively, an appreciable increase on previous years. Nevertheless, despite high prices, the cotton area in the United Provinces is far below that of the years 1913 and 1914 when the area exceeded

1½ million acres. The importance of discovering means which will render cotton cultivation more profitable in this province is therefore obvious.

BURMA. The botanical study of the various Burmese cottons is being continued at the Mahlaing farm where the principal line of work is the improvement of the Wagale type by pure line selection, and by hybridization with Shan cottons of superior staple. By selection strains with a staple of ¾″ and a ginning outturn of 35 to 42 per cent. have been obtained. By hybridization with Shan cottons, strains with a staple length of ⅞″ and giving a satisfactory yield per acre have been obtained. The classification of Burmese cottons was continued, fresh seed being obtained from the Shan States and Chin Hills. Several types have been isolated and are being maintained in pure line culture for the more detailed study of economic characters. Selection work on the Wagyi variety was continued at the Allanmyo agricultural station; 291 tons of seed of a selected Wagale strain was distributed from the Mahlaing farm and seed depôts of the various agricultural unions in the Myingyan Circle. Drill sowing continued to be demonstrated in the Meiktila District; increases in yield amounting in one case to 70 per cent. and in another to 33 per cent. were obtained from the drill-sown crop. The area under Cambodia cotton in the West Central Circle increased from 300 to 600 acres during the year. Considerable success was achieved with the cotton auction market at Allanmyo, over 33,000 *viss* of *kapas* being handled during the season.

The work on cotton in BENGAL is in charge of the Second Economic Botanist; for the investigation of cottons of the Garo Hill type, a farm has been established at Rangmati in the hill tract. In Hill Tippera, Dharwar-American cotton has met with some success; it is possible that the replacement of the local short stapled variety by this type will be economically sound. It is considered that the high lands of Midnapur, Bankura and Birbhum in Western Bengal may prove suitable for cotton cultivation; promising results have been obtained with early maturing strains of Dharwar-American cotton.

The Agricultural Department of the HYDERABAD STATE continued its important work in re-establishing and maintaining the valuable Hyderabad Gaorani cotton (*G. indicum* or Bani). Shortage of seed resulted in a somewhat smaller area being sown with departmental seed.

Cotton-breeding work was continued in the MYSORE STATE on the same lines as in previous years. The acreage under the pure strain No. 69 of the local *herbaceum* cotton has been extended to about 1,500 acres which should produce seed sufficient to sow 10,000 acres in the coming season. The new variety, Mysore-American IV, a hybrid between the local Dharwar-American type and an exotic cotton, is now considered to be practically fixed and is being distributed to selected cultivators for trial.

The BARODA STATE Department of Agriculture has continued to co-operate with the Bombay department, particularly in the establishment of No. 1027 type of Surat cotton throughout the whole of the area south of the Narbada. The seed distributed in 1925 amounted to 361,800 lb. A co-operative society for the joint sale of cotton was started during the year with very promising results. The State continued to enforce the Cotton Transport Act in co-operation with the Bombay Government. The Act is reported to have worked well and has done much to maintain the reputation of the superior cottons of the southern part of Baroda.

IV. Sugarcane.

During the year under review weather conditions were not quite favourable for cane and the condition of the crop was reported to be only fair. According to the final general memorandum for 1924-25, issued by the Director of Statistics, Calcutta, the estimated area under sugarcane and the total yield of raw sugar (*gur*) was 2,530,000 acres and 2,537,000 tons, as against 2,921,000 acres and 3,317,000 tons respectively last year, showing an estimated decrease this year of 13 per cent. in area and 23 per cent. in yield over 1923-24. In addition to this, the crop is grown on a small scale in certain other tracts not included in the above statement; the average for the

last five years for which has been—sowings 185,000 acres with an estimated raw sugar (*gur*) production of 185,000 tons.

The production of refined sugar in India by modern factories and refineries, as apart from the sugar made by small establishments following the indigenous process of refining, amounted to 94,796 tons, as against 74,050 tons in the previous year. The increase was due to the fact that larger supplies of cane were available and the refineries were able to obtain, too, at cheap rates, increased quantities of *gur*, which enabled them to work to their full capacity. As India's requirements of refined sugar are greater than her own internal production, she had to import from abroad about 671,000 tons of white and brown sugars during the twelve months ending 31st March, 1925. After deducting exports and re-exports and taking into account the stocks in the principal Indian ports on 1st April, 1925, it is estimated that 709,000 tons were left for internal consumption in the financial year 1924-25.

On account of the increased production of beet sugar in Europe and of cane sugar in Cuba, sugar prices fell steadily and in consequence Indian imports of this commodity during the year were correspondingly heavy.

The work of raising new varieties by cross-breeding was continued at the CANE-BREEDING STATION, COIMBATORE. During the year under report arrowing started well, but the setting of seed was prejudicially affected by rainy weather. Over two hundred different combinations were attempted and some two lakhs of seedlings were raised, many of which were of more than average vigour.

This year again seedlings have been successfully raised from the Mungo group of North Indian canes showing distinctive characters. It may be mentioned that this group of canes does not generally possess healthy pollen and cross-bred varieties raised with one parent from this group may have a future in some parts of North India. Attempts were made to simplify further the technique involved in breeding operations. Efforts to secure an alternative method for germinating sugarcane pollen on the stigmas of plants other than *Datura fastuosa*

proved futile. Work on the control of male fertility in sugarcane arrows was carried out during the year and, as the results obtained were inconclusive, it is proposed to continue the experiments on a more extended scale during the year 1925-26 in view of the great importance of these experiments in sugarcane breeding. After the successful experiment tried last year in germinating sugarcane seeds at Anakapalli in the Northern Circars of the Madras Presidency, a further extension of it, *viz.*, the despatch of young sugarcane seedlings to Pusa for trial under Bihar conditions, was attempted. It has been found that young seedlings can be transported from Coimbatore to Pusa—a distance of over 1,500 miles—in a fairly satisfactory manner when (1) adequate provision is made against desiccation during the journey, and (2) adequate precautions are taken in the packing to let in air and light to the seedlings. The result of the experiment will be watched with considerable interest as no such experiment has probably ever been tried elsewhere; if successful, it will open out a new line of work in cane breeding. With a view to maintaining the health and vigour of varieties at the Cane-breeding Station, Coimbatore, a small number of healthy buds from clumps of undoubted vigour and health are selected and the stock is multiplied from these. In breeding varieties attention is paid to their disease-resistance. During the year a paper entitled "Sugarcane Breeding in India—Hybridization to testing" detailing the technique as adopted at Coimbatore was published in "The Agricultural Journal of India."

The work of testing new seedlings suitable for the white sugar tract in North India was continued by the SUGAR BUREAU AT PUSA. One of the important experiments of the year at Pusa has been that of varying the time of planting. The cane in Bihar is usually planted in February and by the time full germination takes place, the hot weather has well set in, with the result that the plants have a hard struggle to keep going, as no irrigation is given in this tract. The period from the break of the monsoon in June till the beginning of the cold weather allows only four months for growth, whereas cane planted at

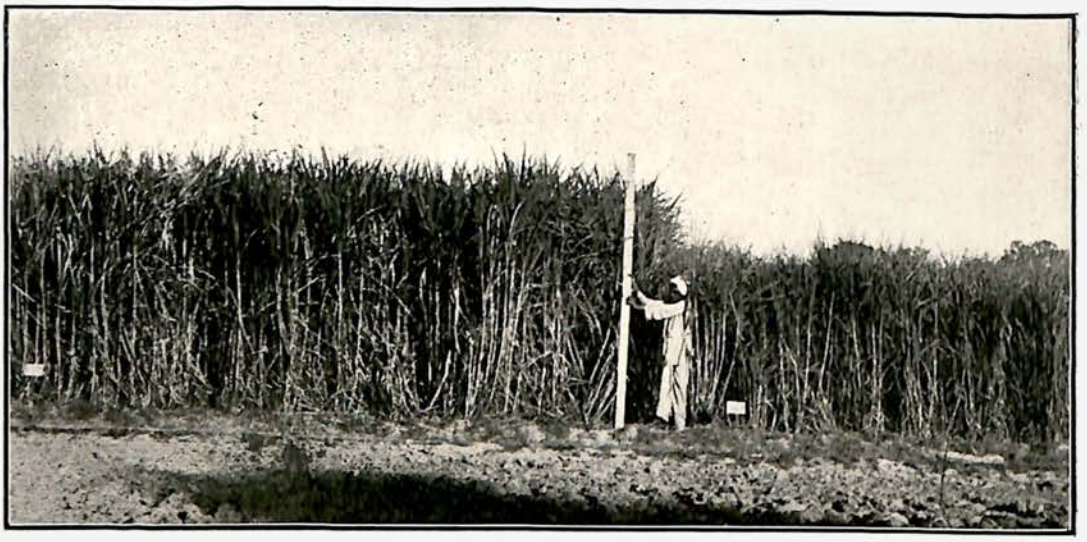
the end of the rains, when the soil moisture and temperature are at their optimum, and a rapid and thorough germination takes place, establishes itself before the severe cold weather sets in. It is thus in a position to continue growth in February and March and to withstand the hot weather. Moreover, this system, if successful, will enable cane to be grown on light lands, which unlike heavy soils frequently lack sufficient moisture in February. The results so far obtained are promising, and this practice is now being tried by some growers who have visited Pusa and seen its possibilities.

The distribution from Pusa of the three improved seedlings Co. 210, Co. 213 and Co. 214 resulted in some 1,500 acres being planted with these varieties in Bihar alone, while over 5,000 acres were planted there last February. Over 3,700 tons of seed-cane of these improved varieties (of which Pusa contributed nearly 370 tons) was distributed during the 1925 planting season to new centres in Bihar. Small lots were sent as far as Peshawar, Allahabad, Nalbari, Mergui (Burma), Gujarat (Bombay) and Aurangabad (Deccan) in India, and to Cuba, Argentina, Porto Rico and Java.

As the monsoon in 1923 proved a failure in Bihar, the local Hemja fared very badly in the summer of 1924; the improved canes stood the drought successfully, and with the advent of a good monsoon in 1924, the Co. 213 gave high yields of over 37 tons per acre on several plantations. As a result of demonstration and propaganda carried on by the Sugar Bureau, the standard of cane cultivation in Bihar districts is improving steadily; improved types of implements are coming into use and the practice of manuring with concentrated fertilizers like oil-cake, sodium nitrate, ammonium sulphate and superphosphate is being adopted with considerable advantage. Ratooning experiments were repeated at Pusa; Co. 210 again proved to be the best ratooner. The system of " short " planting is now widely practised by the growers in Bihar.

Rohilkhand, Meerut and Gorakhpur are the three important sugar producing divisions in the UNITED PROVINCES. Some

PLATE III.



Co. 205 Katha (local cane)

Grown without irrigation at the Government farm, Gurdaspur (Punjab).

Katha (local cane) Co. 205

In a ryot's field under waterlogged conditions at Lahiri Ghista (a village near Gurdaspur). In the foreground stubbles are seen after the paddy harvest.

1,078 tons of improved seed-cane were distributed from different circles; and improved types of implements and oil-cake manures were supplied to cane-growers. Many central sugar factories are working in the Gorakhpur District, where centrifugal machines for working *rab* into sugar and molasses are also becoming, so to speak, a part of the equipment of private farms. In the Hardoi District, the introduction of Java canes has rendered it necessary to instal small power crushing mills and improved boiling plant to deal with the larger yield of cane now obtained. A factory equipped by a *khandsari* from Shahjahanpur with the small power crushing mills and boiling plant designed and installed by the Agricultural Engineering Section of the department worked profitably. In the Bijnor District, it is intended to start a 60 acre cane farm for work on the lines followed on the Shahjahanpur and Hardoi farms. Imported sugarcanes selected and acclimatized at Shahjahanpur were found to be suitable for the better drained soils of Rohilkhand and Oudh, and selected Coimbatore seedlings for lands with limited moisture. Co. 213 on account of its excellent habit was but slightly affected by the storms which occurred at the end of the monsoon. Moreover, it has proved to be a heavy yielder and is seldom attacked by jackals. It requires, however, a longer growing period than some of the other selected canes under trial. Co. 214, Rakra (A. 42) and Katara (A. 47) were tested for their drought resisting and early maturing qualities. The yield of cane and *rab* in these experiments was over 18 tons of cane and nearly 4,800 lb. of *rab* per acre, respectively, which is considerably higher than the average yields in Rohilkhand. This gratifying result was obtained by a simple modification of the cultivators' usual method, *i.e.*, continued after-cultivation up to and during the early part of the monsoon rain, which conserves the natural moisture and aerates the soil.

In the PUNJAB, Co. 205 again proved a heavy yielder under a very wide range of conditions. It gave at Gurdaspur average yields of 3,472 lb. and 2,380 lb. of *gur* per acre on well-irrigated and non-irrigated land respectively, while under canal irrigation at Lyallpur the outturn of *gur* per acre was 5,760

lb. On non-irrigated soil, the gross money return in favour of Coimbatore 205 as compared with the local cane Katha was Rs. 54 per acre. Among the new Coimbatore seedlings, Co. 223 promises to rival Co. 205 in yield; but like Co. 205 it is late in ripening and gives *gur* of somewhat inferior quality.

At Tarnab in the NORTH-WEST FRONTIER PROVINCE, Assami Red has definitely proved its superiority over the local Paunda; it requires less irrigation and gives a higher outturn of *gur*. The quality of the latter is, however, considered to be inferior to that of Paunda. Co. 213 is reported to suffer from the same disability though superior to Paunda in other respects. The method under trial of preserving unripe green cane tops in clamps from 20th November to 20th March for use as seed-cane, has passed the experimental stage. In future green tops only will be used for planting at Tarnab.

As already mentioned, improved Coimbatore canes 210, 213 and 214 are now being grown on a large scale in North BIHAR; of these the seed-canes were supplied from Pusa. As the result of trials on the Sabour farm, Co. 213 has been adopted as the most suitable cane for South Bihar, and co-operative societies in Bhagalpur and Monghyr Districts are energetically helping in its spread. This variety has proved very drought resistant on the Cuttack farm, and is being grown in Orissa on drained paddy-lands which never grew cane before.

Elaborate selection work both on local and exotic varieties from practically every cane-growing tract in the world has been done at Dacca in BENGAL. Tanna has emerged from this investigation as the most suitable cane, more especially for high land cultivation. It is a hardy, drought-resisting, heavy yielding *gur* cane. It is not damaged to any great extent by jackals and is consequently very popular with cultivators. Co. 213 did very well at Rajshahi, Berhampore and Dacca.

As regards the date sugar industry, examination of the juice from date trees in the experimental plantation at Dacca has been continued and the investigation has been extended to sucrose content. Ash analyses are also being made with a view to ascertaining the mineral requirements of these trees.

Work on sugarcane in ASSAM is carried out at Jorhat. The conditions in Assam are favourable for thick canes which do not as a rule ratoon well, while the scarcity of labour makes the question of ratooning of considerable importance. Of the varieties under trial, D. 74, a good cane but a late ripener, gave the highest yield (32 tons per acre). J. 33a was the best of the ratoon canes both in tonnage and sucrose. It gave an average yield of 20·98 tons of stripped cane and 1·95 tons sucrose per acre; but cultivators do not like this variety as owing to its hard rind it is very hard to crush. Co. 9 shows the highest yield of sucrose; it gave over 30 tons stripped cane per acre. It is a good plant cane, but its ratoon results put it out of court with the ryot.

Four new seedlings introduced from the Cane-breeding Station, Coimbatore, were put down for multiplication at Tatkon in BURMA. Attempts have been made to grow canes for seed in the Southern Shan States in accordance with the well-known practice of growing seed-cane at high altitudes to preserve their vigour.

For the Deccan canal areas in BOMBAY the local cane known as Pundia is considered an excellent variety; but the Agricultural Department has a number of new varieties which are being introduced. Red Mauritius has almost replaced the local variety in the Konkan; it is a more vigorous cane and gives a larger yield.

Safflower and groundnut cakes are now being extensively used as a manure for cane in the Deccan; sulphate of ammonia is also freely used.

Experimental work on cane was done chiefly at Anakapalli, Samalkota and Palur in MADRAS; among the improved varieties are J. 247, Red Mauritius, Co. 1 and Java Hebbal, of which the first is recommended for cultivation in the Northern Circars.

At Anakapalli the system of "short" planting for seed multiplication has been adopted with great advantage, and the system of planting in lines has been introduced with considerable success in the Northern districts.

In Chittoor and North Arcot, J. 247 is forging ahead, while in South Kanara where Red Mauritius is being introduced by the department, there are about 4,000 acres under this variety but the crop appears to have reached the limit of extension here.

In the Northern Circle of the CENTRAL PROVINCES the Coimbatore varieties were tested against the variety Khari and in most cases showed a distinct superiority, while on the Tharsa farm in the Southern Circle they again proved their suitability to the district and yielded a net profit of over Rs. 500 per acre, a much better return than that of the standard variety Khari. The advantages gained by the application of a quick acting manure to supplement the ordinary dressing of cattle manure and the fact that the full benefits of irrigation cannot be obtained without manuring were also demonstrated. After a series of tests the most economical 4-year rotation for cane was found to be, cane, ratoon, groundnut and wheat, followed by groundnut alone in the fourth year. On the sandy loam of Wara-Seoni farm excellent yields of *gur* amounting to upwards of 4 tons per acre were obtained, the best varieties being Co. 213, Co. 210 and Co. 219. The cultivation of sugarcane is attracting more attention in the Plateau districts of Chhindwara and Betul, and types of cane suitable for *gur* making are in request.

The area under cane in MYSORE is on the increase, and the distribution of new varieties from the departmental farms has been well maintained. In the wet tracts of Mysore experiments with different varieties of canes showed that H. M. 553, J. 33a and H. M. 602 were the best yielders. H. M. 544 stood only fourth in the order of yield, but as it possesses superior milling qualities it maintained its popularity. Manurial experiments on cane with ammonium phosphate were carried out on Babbur and Marthur farms and gave better results than ammonium sulphate.

Fiji B and 35 and Vadi 75 have so far been found to be very good varieties in the HYDERABAD State.

As a result of experiments carried out on central farms in GWALIOR the superiority of A. 42 has been established over the local cane.

Cane experiments were conducted at Trivandrum, Nagerooli, Eraniel, Shencottah and Alwaye farms in TRAVANCORE. Manurial and cultural demonstrations were carried out on ryots' lands, the manure and seed required for the purpose being distributed free.

V. Jute.

Being an essential requisite of international commerce, jute is far and away the most important of the lower grade fibres. At present the world's supply of jute fibre is obtained almost entirely from North-East India, and in years in which the yield is poor the cultivator is recompensed by higher prices. During the year under review, a prolonged drought delayed sowing in Bengal which carries 83 per cent. of the total area, and only 2,770,000 acres were sown with this crop as against 3,058,000 acres in the quinquennium immediately preceding the Great War. Unfavourable weather conditions at a subsequent stage also affected the outturn and the total outturn of 8,062,000 bales of 400 lb. each represented only 1,065 lb. per acre, as compared with the normal yield of 1,330 lb. This shortage of output combined with the revival of the demand from abroad secured record prices for the growers. Though the value of raw and manufactured jute exported during the year amounted to Rs. 80,85 lakhs as against Rs. 62,28 lakhs in the preceding year, there was no material increase in the quantity sent overseas.

As stated above, 83 per cent. of the area under jute is in BENGAL, and it is to the credit of the local Agricultural Department that they have isolated and brought into general cultivation superior yielding, disease-resistant strains of the two main species cultivated, *viz.*, *Corchorus capsularis* and *C. olitorius*. The improved races of the former are D. 154 and R. 85 which have been isolated for resistance to chlorosis from the well-known Kakya Bombai; while Chinsura Green is the name by which the *olitorius* selection is known. On an average these departmental selections yield 250 lb. more fibre per acre than the local varieties; during the year under report they occu-

pied nearly three lakhs of acres, or over 10 per cent. of the total area under the crop. Dealers in Narayanganj, Chandpur and Madaripur consider that half the imports of jute into these trade centres now consist of fibre produced from departmental races. The Director of the provincial department would appear to be quite justified in estimating that during 1924-25 the additional profit to the cultivators who are growing improved races aggregated Rs. 90 lakhs. The search for still better varieties continues, and hundreds of new races evolved by selection or hybridization are under trial at Dacca. One of these called D. 27 is most promising; when grown side by side with D. 154 it not only gave a higher yield but also produced a better fibre. Sufficient seed of this race has been produced for a test on a more extensive scale.

The investigation into the correctness or otherwise of an old standing conviction in the jute trade that the environment, and not the seed, is the determining factor in the quality of the fibre, is being continued at different centres under different soil and climatic conditions in collaboration with the Indian Jute Mills Association and the Dundee Chamber of Commerce. As far as the investigation has progressed, there appears to be a distinct indication that the kind of seed influences the fibre produced, but that the environment is also a powerful factor. Though, judging from the respective appraisements of the samples from the 1923 crop, there is apparently a distinct difference between the requirements of Dundee and Calcutta, both placed D. 154 from Kishoregunj (Mymensingh) first for quality.

Manurial trials at Dacca indicate the superiority of potash in combination with bonemeal and lime over potash alone. It has also been proved that a cold weather green manure preceding jute materially increases the yield of the latter. Further observations on the inheritance and incidence of chlorosis have definitely proved that the chlorotic condition can be carried by the male parent, and that healthy plants cannot be infected by chlorotic plants.

The Bengal selection Kakya Bombai has achieved such high repute in the jute-growing tracts of BIHAR that there was

a demand for 5,000 lb. of seed at the high rate of Rs. 30 per maund (80 lb.) when the local rate was Rs. 16. The establishment of the Purnea farm will enable the local department to make a larger supply available from the year (1925-26), and to ascertain definitely whether the popular belief that seed imported from Bengal always gives a higher yield of fibre than that locally raised, is well founded.

In a test carried out in ASSAM, D. 154 maintained its reputation as the highest yielder among the Dacca selections. In future seed of this strain will also be distributed along with that of Kakya Bombai and R. 85 which are already in popular favour. The latter, when tested against the local varieties in different parts of Assam Valley, gave an increase in yield ranging from 197 lb. to 458 lb. per acre.

The introduction of jute in the Ganjar tract (Sitapur and Kheri Districts) of the UNITED PROVINCES, where conditions are similar to those obtaining over large areas in Bengal, has proved so successful that the acreage has risen to 2,000 acres. There is a demand for the present limited produce in the local bazaars for rope-making; but the organization of a market is considered essential for any rapid extension of the area, and steps are being taken in that direction.

A field experiment has been laid down at PUSA to determine the influence of manurial treatment on the incidence of stem rot disease in jute.

VI. Other fibres.

Sann-hemp. Work in connection with the artificial extraction of fibre was continued and progress made in estimating the possibilities of the machine in use at Pusa. When certain necessary alterations are made in the machine, it is expected that the present high cost of production will be considerably reduced. The question is of very great importance for the United Provinces, the Punjab and the Central Provinces where the crop is highly appreciated for its fibre and manurial qualities but where the absence of retting facilities prevents any great extension of cultivation.

An experiment carried out during the year at Dacca has confirmed the conclusion previously arrived at, at Pusa, that the same crop of sann-hemp can be used both for manure and fibre by ploughing in only the roots and tops and retting the stems. It is estimated that from an average crop of nine tons (green weight) 31 lb. of nitrogen would be returned to the land in this way.

The possibilities of hemp fibre as a substitute, partial or otherwise, in the manufacture of canvas, are also under investigation in Bengal.

Sida. The work on the selection of non-branching *sida* races was continued at Dacca, and a bulk sample of the fibre sent to Dundee for appraisement.

Sisal. The propagation of the strains which pole late as distinguished from those which pole early is proceeding. The longer lived variety is the more profitable to cultivate because the expense of replanting it recurs much less frequently.

Roselle. Further investigations on the inheritance of colour in the capsule and corolla of *Hibiscus Sabdariffa* were carried out at Pusa. Measurements of the pollen grains, leaf-factor and root-system showed that all four varieties were similar in these characters, the sole distinction lying in the distribution of colour.

VII. Tobacco.

On an average a little over a million acres are cropped with tobacco in India, of which about half the area is situated in Bengal and Madras. The other tobacco tracts of importance are in Bihar, Burma and Bombay. The varieties of tobacco indigenous to India give a somewhat coarse leaf which, to some extent, meets the local demand. The cheap foreign cigarette has, in recent years, however, brought about a change in the public taste, and a great demand for a cigarette tobacco possessing the flavour of the imported Virginian cigarette has grown up in the country. In 1924-25, India imported cigarettes, cigars and tobacco leaf of the value of 197 lakhs of rupees; she exported in the same year tobacco worth 125 lakhs

PLATE IV.

AMERICAN CIGARETTE TOBACCO ADCOCK GROWN AT PUSA.

of rupees. The possibilities of developing a bigger export trade, particularly with Great Britain, is greater now than ever before, consequent on the fact that Great Britain has reduced her customs duties on Empire-grown tobacco; but the type for which there is a keen demand abroad is just what is also required for establishing an indigenous cigarette industry. The programme of the Agricultural Department, therefore, aims at producing a tobacco of the colour, flavour and texture of that which is commonly called Virginian. Similarly, the production of genuine Indian cigars can be assisted by providing a better outer leaf or wrapper of finer tobacco.

With a view to evolving a type of tobacco which will resemble the American strains in flavour, colour and smoking qualities, while possessing the hardiness and growing qualities of the best Indian varieties, the American Adcock and White Burley have been crossed at PUSA with the well-known selection, Pusa Type 28. Different methods of curing the leaf are being investigated. Very good results were obtained during the year in the curing of White Burley by air curing on racks, both by the split stem method and by stringing the leaves. The finished article was but little inferior to the produce of the tobacco-growing states of America. The chemical changes occurring in the leaf under different modes of curing are also under study.

The tobacco crop is to receive special attention at the newly opened farm at Purnea in BIHAR, and it is proposed to carry out there breeding work on the lines which look so promising at Pusa. Pusa 28 tobacco was again grown at Sepaya to verify the previous year's results which indicated that the crop could be successfully brought to maturity in the Saran District, though the popular belief is otherwise. The results were even more encouraging than last year; in the opinion of a representative of a cigarette factory who visited the farm, the crop was as good as anything he had seen in Madras. This successful experiment has not failed to attract notice in the surrounding countryside, and it is estimated that 250 acres of tobacco will be grown by cultivators in the vicinity in 1925-26.

The improvement of the local races by selection, the acclimatization of exotic cigar and cigarette varieties, and the study of the manurial requirements of the crop are in progress on the special tobacco farm at Burirhat in BENGAL. Among the indigenous varieties, Bhengi has proved to be the heaviest yielder and fetches the highest price. It is purchased mainly by Burmese dealers who use it for the manufacture of the well-known Burma torch cheroots. The other two selections are Matihari suitable for *hookah* and *biris*, and Naokhol much appreciated for chewing purposes. The reputation of the Sumatra leaf grown on the farm as a cigar wrapper has now been well established, and the demand for seed amounts to several times the supply available. Of the filler varieties introduced three years ago, Pennsylvania Board seems to be the best, with Manilla No. 2 a close second. Four cigarette tobaccos imported from America are under trial and a lemon-coloured leaf of fairly good quality has been obtained by flue-curing, but the method has yet to be perfected. The manurial experiments indicate that the system of manuring adopted for the Sumatra variety gives the best results if preceded by a green-manure crop; and that mustard cake is an excellent substitute for cowdung which is both expensive and difficult to obtain. A dose of potash manure has been found to increase the amount of dried leaves.

The Bengal selection Matihari has proved very successful wherever grown in ASSAM. Its cultivation is increasing specially in the Surma Valley.

Pusa 28 is finding favour in parts of BURMA where it is reported to yield more and finer leaf than the local varieties. The local Government has sanctioned the opening of a special station near Thayetmyo for the study of tobacco growing and tobacco curing problems.

The selection work on the Nadiad farm in BOMBAY has resulted in the isolation of a type (No. 6) for the Indian market which yields at least 20 per cent. more than the local mixed crop. It is less expensive to grow, too, as it is sucker-resisting. The seed of this pure line was distributed in the district for the first time during the year under review.

VIII. Oil-seeds.

The area of 18,076,000 acres under the principal varieties of oil-seeds—linseed, rape, mustard, sesamum and groundnut—was higher by only 232,000 acres than that of the previous year. The estimated yield of 3,667,000 tons represented an increase of 530,000 tons, the outturn per acre of linseed, sesamum and groundnut being better by 50,26 and 270 lb. respectively. The total quantity of oil-seeds (including castor and cotton seeds) exported during the year was 1,325,000 tons (valued at Rs. 33,16 lakhs), as against 1,255,000 tons (valued at Rs. 29,81 lakhs), and that of oil-cakes 195,000 tons, as against 178,000 tons in the preceding year. While the exports of whole seeds are below the pre-war average by 118,000 tons, those of oil-cakes show an appreciation of 45,000 tons. This indicates that though more seeds are crushed locally, there is no demand in the country for larger amounts of cake for cattle food and manure.

Linseed. By isolating and classifying the unit species which make up the Indian linseed crop at PUSA it was found that the types fell into two main classes—one suitable for the soils of the Peninsula, the other for the alluvium. Those adapted to the conditions of Peninsular India are large-seeded and of higher oil-content, but their root-system is not suited to the conditions of growth in the alluvium. Hybridization is, therefore, being employed for producing a large-seeded race which can be successfully grown in Bihar and the United Provinces which between them contain half the total area under linseed. In the year under report the two Pusa types (12 and 121) recommended as giving high yields in Bihar yielded 1,148 lb. and 984 lb. respectively.

After a process of selection covering some years, two white-flowered varieties have been isolated at Sabour in BIHAR, which give promise of having the wilt-resisting property.

In the UNITED PROVINCES, two varieties have been found which are not only rust-resistant but have a high oil-content. These are being used as parents in making crosses with higher yielding varieties which are less resistant to rust.

Mustard. In ASSAM where mustard is the most important *rabi* crop, varieties from different parts of the country have been collected on the Jorhat and Titabar farms for selective breeding from the point of yield. Similar work is also in progress in BENGAL.

Castor. The oil-content of castor and a number of problems connected with its growth have been investigated in the United Provinces. The results are being embodied in a bulletin.

Sesamum. A collection of different varieties of sesamum grown all over India has been made at PUSA for the isolation of unit species. Thirty-three cultures of sesamum are under trial at Mahlaing in BURMA with a view to selecting a higher yielding substitute for the previously selected Pyigyi. An investigation into the causes of the condition known as " green-flower," which often seriously damages the crop, has proved that it is not inherited.

A few varieties of sesamum with a high percentage of oil-content have been fixed in the UNITED PROVINCES and are being grown for further trial.

Groundnut. Sixty-five per cent. of the area under groundnut is in MADRAS, where varietal, manurial and cultural experiments are in progress at two stations.

In BURMA, Spanish groundnut repeated last year's performance and definitely proved itself to be superior in yield to local varieties.

The introduction of quick-growing varieties of high oil-content in BOMBAY has led to the expansion of groundnut cultivation, especially in Khandesh and North Gujarat. In 1912-13 the area under groundnut in these two districts was about 4,500 acres; the acreage has increased to 1,80,000. This increase means that a crop worth Rs. 40 per acre has been replaced by another worth Rs. 80—100.

The selection work at Ranchi in BIHAR AND ORISSA has yielded a type called Kanke 17 which is being distributed in the Chota Nagpur plateau. The cultivation of groundnut is spreading in the Patna and Bhagalpur Circles where it has proved a valuable crop on poor sandy soils. As remarked in the annual report of

the Nawada Central Co-operative Bank, " the yield fetches an average income of Rs. 100 per acre on land in which the cultivators used to grow only *kurthi*, etc., the yield of which has never exceeded Rs. 16 per acre." The search for a more prolific variety of the erect type has yielded three strains which are considered suitable for general distribution.

Coconut. Experimental work at Kasargod in MADRAS has demonstrated the possibility of raising coconuts without any irrigation whatsoever, provided deep ploughing is done in the first instance and the top layer of soil frequently stirred during the hot weather to conserve soil moisture. Forty demonstration plots laid down in the previous year under this dry system of cultivation, stood the test thoroughly, and 131 new plots in South Kanara and 30 in Malabar were brought this year under the new method.

Land has been acquired at Puri in ORISSA for a special coconut station. The plantations at Cuttack, Khurda and Balasore are doing well.

At Akyab and Kyaukpyu in BURMA, data regarding the best method of cultivation of the coconut palm in Arakan are being collected.

In TRAVANCORE, manurial and spacing experiments were continued and a large number of disease-resistant coconut seedlings sold.

The Pest Act continued to be in force in Madras for the control of the coconut caterpillar.

IX. Tea.

The area under tea, about 83 per cent. of whch lies in Assam and in the adjoining districts (Darjeeling and Jalpaiguri) of Northern Bengal, rose from 711,189 acres of the preceding year to 716,221 acres in the year under review. The estimated yield of 375,255,874 lb., however, showed a small reduction of 99,815 lb., the average production for the whole of India working out at 550 lb. per acre plucked, as against 581 lb. in 1923.

This was the fourth successive year of prosperity for the tea industry, the average price of about a rupee per lb. being the

highest ever known since the beginning of the industry in North-East India. The exports of 340,107,000 lb. by sea were valued at Rs. 33,39 lakhs; in addition 7,571,872 lb. were sent out by land. It would therefore appear that the bulk of India's production is absorbed abroad and that the present phenomenal prices are due to the supply falling short of the world's demand.

The scientific staff of the Indian Tea Association has been investigating problems relating to the improvement in yield, through soil treatment and the control of disease and pests. As far as the work has progressed, it appears probable that on soils of high acidity liming will prove indirectly useful in reducing the liability to tea blights. Observations on the organisms associated with tea manufacture suggest the conclusion that during the periods when the number of yeast cells naturally present on fresh leaf is greatest the quality of tea manufactured is the best. The results of pruning trials in progress during the last seven years show the loss in crop, produced by cutting down, to be greater the further the tea is cut down.

In Southern India, the crop is dealt with on similar lines by the scientific staff of the United Planters' Association which has been strengthened by the appointment of a Tea Specialist. In the lower elevation districts where sun-burn and branch canker are responsible for much damage, early pruning in August or September, instead of in December as is the usual practice, has been found to reduce the incidence of disease without affecting the total outturn of leaf. Experimental work is in progress to ascertain the most suitable time for applying manure to tea bushes.

X. Coffee.

The Indian coffee industry is practically confined to a tract in Southern India, comprising part of the Madras Presidency, Coorg, and the States of Mysore, Travancore and Cochin. The area occupied by the crop is in the neighbourhood of 130,000 acres, while the production of cured coffee fluctuates between 20 and 25 million lb. There was a good demand for Indian coffee from abroad at fairly high prices, and the year under report was

a profitable one for the industry. The quantity exported, namely, 242,000 cwt., exceeded that of the previous year by 9 per cent., but the value of the exports, namely, Rs. 2,08,95,000, represented an increase of 33 per cent.

At the scientific station of the United Planters' Association of Southern India, comparative tests with Kent's selection and Jackson's hybrid show that the former does better than the latter. Two main types have been selected from Kent's, *viz.*, one similar to Coorg, the other resembling Chick, of which " A " has during the last two years produced more crop than " B ". In the manurial trials, the all-round manured and compost-manured plots have done best.

Spraying with Bordeaux mixture has increased the leaf area and reduced the loss of crop which occurs between the setting of the blossoms and the time of harvesting.

XI. Rubber.

Rubber is grown mainly in Southern India and Burma; in the year under review the area amounted to 129,458 acres, which is 1 per cent. above that of the previous year. Of this area, only 81,918 acres were tapped. The total production of raw rubber during the year is reported to have risen to 15,601,296 lb. as against 14,462,504 lb. for last year. The quantity of 18 million lb. exported to foreign countries showed an increase of 17 per cent.

In Southern India, a highly satisfactory method of budding Hevea rubber under local climatic conditions has been arrived at, in which an H cut is made in the stock and the bud inserted by raising the two lips, both being afterwards closed and bound down tightly over the bud. The Rubber Mycologist has also devised an anti-drip device for reducing the loss of crop during the monsoon.

Spraying with Bordeaux mixture has proved such a cheap and effective remedy for checking secondary leaf-fall, that it is expected that during the coming spraying season at least 10,000 rubber trees representing every estate will be sprayed.

With a view to determining whether destructive distillation of rubber had economic possibilities several tests with scrap rubber were carried out. The results were not favourable, the product obtained being less valuable than the material used.

Black thread and abnormal leaf-fall are the two diseases of rubber under investigation in Burma; the remedy recommended for the former consists in stopping tapping as soon as the monsoon breaks.

XII. Fruit.

In the absence of trained specialists only isolated efforts have hitherto been made to popularize better varieties of fruits, improved methods of cultivation, etc., in India. A thorough investigation of the economics of fruit growing as a subsidiary industry is, however, very necessary in a country which offers wide scope for fruit culture and where the small holders are badly in need of an additional occupation. Further, fruit growing can employ and ought to attract a large number of the educated classes who are in search of employment, but are not suited for other classes of farming. Progress in these directions cannot be anticipated until a special Horticultural Section is attached to the Imperial Department as well as to all Provincial Departments of Agriculture.

In the NORTH-WEST FRONTIER PROVINCE, very excellent work has been done on fruit culture. Exotic varieties of peaches, plums, pears and apricots have been selected at Tarnab after trials extending over 14 years; these improved varieties not only yield more but also fetch prices which are three times higher than those obtainable for the old Peshawar kinds. With a view to demonstrating to the frontier fruit trade that the adoption of these improved varieties, together with good orchard practice and reasonably up-to-date business methods, means a net profit of not less than Rs. 500 per acre throughout the entire life of the plantation, an orchard of 32 acres has been laid down at Tarnab which will be run on a commercial basis.

The fruit farm started by the Howards at Quetta in BALUCHISTAN has greatly benefitted the province and is now practically self-supporting. The farm is doing most useful work.

It supplied this year 8,740 grafted and budded fruit plants of the best varieties. As a demonstration farm also it serves a most useful purpose.

The pomological station at Coonoor and the fruit gardens at Kallar and Burliar in MADRAS paid their way during the year under report. The financial results would have been better if all the trees ready in the nurseries could have been disposed of. The outstanding feature at Burliar was the record crop of mangosteens obtained. This fruit tree has, however, failed to grow at Taliparamba. A plot of 78 cents cropped with plantains gave a return of Rs. 1,149 at Samalkota.

The newly established horticultural garden at Hmawbi in BURMA has been planted with Nagpur oranges, Malta lemons, Arakanese sweet limes, West Indian pineapples and the African oil-palm.

The fruit-growing experiments at Shillong are being continued by Mr. Holder, to whom the orchard has been leased by the ASSAM Government. Grafted fruit trees from this garden are in considerable demand in the province.

The fruit trees of temperate and sub-tropical zones under experiment at Chhindwara in the CENTRAL PROVINCES are making good growth. Climatic difficulties are, however, reported to have interfered with their fruiting capacity.

Taking India as a whole, the general position would appear to be that for want of technical experts the fruit industry, which is one of very great possibilities and should be of great importance, is neglected. Excellent work has been done by a few isolated workers, but these workers unfortunately have had other duties to perform and there has been no real continuity of effort towards improving this promising industry.

XIII. Fodder crops and grasses.

In the past when large grazing areas were available, the cultivator relied very largely on Nature to provide food for his cattle in the form of pasture. With the ever-increasing pressure on the land, much of the area previously used for grazing has in

course of time come under the plough, but the cultivator has not yet learned to grow on arable land the fodder required for cattle maintained by him for milk and draught. Moreover, cattle-owners do not, as a rule, make any effort to carry over the surplus fodder available at the end of the rains, for use in the hot weather when pasture lands are parched and bare; nor do they carry over surplus fodder available in years of plenty for use in years of shortage. The Agricultural Department has of late years given much attention to the question both of growing and storing fodders. Several very promising fodders have been introduced and methods of storing them in the dry state or as ensilage adopted. It has been definitely proved that palatable ensilage can be made from coarse grasses, weeds and other herbage which in most parts of India are available in considerable quantities towards the end of the rains. Crops such as maize and *juar* cut and siloed when in flower also make excellent silage as experience has shown on almost every Government farm.

The introduction into India of the famous Egyptian clover and soil renovator, which is now being successfully grown in Sind, Bihar, the Central Provinces and the North-West Frontier Province, is one of the great achievements of the department. In the last mentioned province, it is slowly but surely ousting the hitherto much appreciated shaftal and the cultivators are producing seed for sale. This is a great step forward, as nearly all the berseem seed used in India heretofore has had to be imported from Egypt. It is being grown on a large scale at PUSA, where it is followed in the same year by a crop of early maize. The berseem is mostly grazed by tethering the farm cattle in the field. By this system the soil is enriched to such an extent by the clover that large crops of maize are obtained as a second crop. During the year under review, 96 acres of berseem provided from December till June all the green food required for the herd of nearly 500 cattle. After meeting the full requirements of this large herd, there was enough clover left to make about 40 tons of clover hay. The maize crop of 92 acres supplied full pasturage for two months and provided as well 520 tons of green stuff for silage. Thus by cropping a comparatively small irrigated area of poor land with these two crops, a large herd

SILAGE MAKING WITH MAIZE. ABOUT 25,000 MAUNDS OF MAIZE ARE USED EACH YEAR FOR SILAGE AT PUSA.

PLATE V.

was provided for the greater part of the year with all the bulky green fodder they required. The abundance of luscious berseem available in the winter and summer months of the year largely accounts for the fact that the average milk yield of the dairy herd during that period exceeds their yield in the monsoon by over a couple of pounds per cow per day.

The method of silage-making adopted at Pusa is also of great importance. The maize used for ensilage is shredded and blown into *kutcha* pits by an International silage-cutter driven by a portable steam engine, after which the pits are covered with a layer of litter and earth. When the pits are opened over 75 per cent. of the maize is recovered as first class silage which is fed to the herd when no other green food is available.

Kessore cane, the sucrose content of which is too low for *gur*-making purposes, is being tried as a fodder at the Cuttack farm in ORISSA. Under irrigated conditions it is capable of giving a number of cuts. At Naterhat a newly introduced perennial grass called *Anthistiria ciliata* has given heavy crops of hay.

In BENGAL, the relative suitability of different fodder crops when grown as catch crops and as cold weather crops is being investigated.

Guinea-grass and Elephant-grass have done well in ASSAM; the demand from cattle-owners for clumps for planting is gradually increasing and is being met from the Jorhat farm.

A collection of fodder *juars* has been made at Mahlaing in BURMA, and saccoline (a variety of sweet *juar*) introduced from New South Wales has been crossed with ordinary *juar*, with the object of obtaining a hybrid strain having a sweet stalk and the superior grain of the local sorghum.

Sunflower, saccoline and the small bamboo (*Dendrocalamus strictus*) have been introduced on the cattle farms of the UNITED PROVINCES, and their feeding value is being investigated. Sunflower has proved useful as a source of green fodder for the cold weather and the early months of summer; saccoline grown as a *kharif* crop has given a good yield of palatable fodder. The small bamboo imported from the Central Provinces has become

established at Manjhra and will be a valuable source of fodder in times of scarcity.

Methods of improving the yields of fodder on the millions of acres of very poor grass land in the Deccan and other parts of the BOMBAY PRESIDENCY are under investigation. Methods of storing *juar kadbi* (dried *sorghum* stalks) on a large scale in years of plenty are also being tried.

The Kikuyu grass (*Pennisetum clandestinum*) imported from South Africa three years ago is flourishing at Tarnab in the NORTH-WEST FRONTIER PROVINCE. A ten-acre plot of this grass provides the farm stock of about 60 cattle and 75 sheep with abundant grazing from March to December. This grass is being tried, too, in the United Provinces, the Central Provinces, and at Pusa.

Further feeding trials with *shisham* (*Dalbergia sissoo*) silage in the PUNJAB have definitely shown that it may prove a valuable emergency fodder. Twenty-four bullocks were, for a period of 19 days, each given 16 lb. of this silage daily; they did not suffer from any digestive trouble during this time or become less efficient draught animals.

XIV. Juar (Sorghum).

Of the millets grown in India, *juar* is the most important. It covers an area of nearly 30 million acres, and thus, from the point of acreage, occupies the third place among the cultivated crops of the country. Nearly two-thirds of this huge area is situated in Bombay, Madras, the Central Provinces and the Hyderabad State where the grain forms the staple diet of a large section of the population. As its dry stem (*kadbi*) is a useful cattle food, this crop plays an important part in the agricultural economy of a large portion of the country, supplying as it does food for man and beast.

In BOMBAY, considerable progress has been made at Surat and Dharwar in the isolation of superior strains which yield 15 to 20 per cent. more grain per acre than is obtainable from the seed ordinarily used. The practice of ridge cultivation which has consistently given a yield 25 per cent. greater than cul-

tivation on the flat, has spread to the fields of cultivators. The method is applicable to several lakhs of acres in Lower Gujarat where the crop suffers from waterlogging in black soils. From the keen interest evinced in this method it is believed that its wider adoption is only a question of time.

The Millets Specialist in MADRAS has isolated two strains of *juar* which gave a bigger yield than the old selection Nandyal No. 6.

The varieties of *juar* recommended in the CENTRAL PROVINCES are Saoner, Ramkel and Lamkansi. They give from 12 to 20 per cent. higher outturn than the *juars* commonly grown.

The value of copper sulphate as a preventive for *juar* smut is now fairly well known in *juar*-growing provinces. It is estimated that in Bombay alone seeds for nearly 3½ lakhs of acres were steeped last year. This means a saving of crop valued at from eight to ten lakhs of rupees. In the Central Provinces, the use of copper carbonate is also recommended; though not so cheap as copper sulphate, the vitality of seed treated with it is not affected by being stored.

XV. Ragi (Eleusine coracana).

Of the area of nearly 67 lakhs of acres under *ragi*, over 48 lakhs are in Madras and Mysore. In the latter State, *ragi* is the premier cereal crop, and work on its improvement is in progress at Hebbal. In H. 22 the department has already got a strain which has achieved wide popularity, but its late maturing character renders it unsuitable for certain districts. The object aimed at now is to isolate a strain of *ragi* which will be as good as H. 22 in yield and drought-resistance but will ripen about two weeks earlier. The high yields of *ragi* obtained on State farms by the application of ammonium sulphate have created some demand for this manure.

In MADRAS, 293 single plant selections have been made as a preliminary to the study of the crop.

At a special research station in the uplands of the Konkan in BOMBAY, types of *ragi* have been isolated which yield 20-30

per cent. more than the ordinary seeds now in cultivation. Large-scale trials are in progress with these promising types.

XVI. Potatoes.

The potato crop is steadily increasing in popularity in India, and the area under it is being extended year by year in response to the demand for the produce. There are, however, problems, more especially connected with the supply of seed and the control of disease, which will have to be solved before any rapid extension of its cultivation is possible.

In ASSAM, the work of acclimatizing, testing and distributing potato seed is being carried out on the Upper Shillong farm. Among the foreign varieties acclimatized, Imperator, Windsor and King of Potatoes continue to do best. A large demand has grown up for this seed, of which 73 tons were supplied last year. Of the new varieties imported in 1921, Arran Chief and Allay are most promising. The manurial experiments carried out on this crop indicate that potatoes cannot be successfully grown without an adequate application of cowdung and rape cake. The highest yield of 2·82 tons was obtained by an application of 5·5 tons of cowdung, 823 lb. of rape cake and 411 lb. of bonemeal per acre. Fumigation and spraying experiments carried out in the Khasi Hills to combat the late blight of potato (*Phytophthora infestans*) showed that potatoes treated with corrosive sublimate (1 grm. of $Hgcl_2$ in 1 litre of H_2O) and fumigated with petrol are least affected by this disease, and that Burgundy and Bordeaux resin mixtures are effective sprays.

Manurial trials conducted through co-operative societies in the Bhagalpur Circle and on cultivators' plots in the Patna Circle have demonstrated that ammonium sulphate can profitably replace much of the castor cake now applied by cultivators to their potato crop in BIHAR. One plot gave seven tons and a net profit of Rs. 242 per acre.

Of the seven varieties imported from the United Kingdom and Assam, only two, *viz.*, King of Potatoes and King George,

have done well at Yawnghwe in BURMA. They are being multiplied for distribution in the Shan States.

With the wider adoption of the practice of dusting with sulphur against the mite which causes the *tambera* disease in BOMBAY, the growing of potatoes in the *kharif* season on a much larger scale has become possible.

In MADRAS, varietal and manurial trials are in progress at the Nanjanad potato farm. The introduction of potato cultivation in the Shevaroys has received a set-back on account of an unfavourable season.

XVII. Beans and pulses.

Several varieties of beans imported from America, Japan and Egypt have failed to provide a suitable substitute for the white BURMA bean which has fallen into disfavour in importing countries, on account of the prussic acid scare. The local Pebyugale is largely grown on poor soils in rotation with cotton, and it is on these soils that the exotic beans have failed to hold their own with it. An attempt is now being made to isolate from the local crop a strain relatively free from prussic acid. Trials at Padu with several varieties of gram imported from India have not revealed any having a marked superiority over the original selection from Karachi. This variety has remained immune to the wilt fungus attacking Burmese gram and has largely replaced the local variety.

At Sabour in BIHAR, Type 4 has proved superior to all other grams tried. Its yield was equally striking in the tests at Jamui, Sepaya and Gaya. An application of 160 lb. of superphosphate per acre nearly doubled the yield at Jamui.

Breeding work on pigeon-pea is proceeding at PUSA on two lines, namely, the separation of unit species from the mixed crop, and the isolation of a type which will prove resistant to wilt disease.

CHAPTER III.

RESEARCH AND INVESTIGATION.

Besides the work of such immediate economic importance as the testing and introduction of higher yielding varieties of crops, more efficient manures, superior cultural practices and effective methods of combating the ravages of diseases and insect pests mentioned in the previous chapter, a variety of investigations relating to the more fundamental problems of chemistry, bacteriology, mycology and entomology were carried on during the year. They dealt with problems such as the movements of nitrates in soils, the conservation of soil moisture, the fixation of nitrogen in soil by non-symbiotic organisms, the storage of farmyard manure, the relative availability of different organic manures, the utilization of the sources of natural indigenous phosphate, animal nutrition, the effect of grass on fruit trees, etc. As these investigations are still in progress and have not yet reached the stage at which the results can be of practical importance, they are only briefly noticed below. For detailed information relating to the research and investigational work in progress, interested enquirers are referred to the Scientific Reports of the Pusa Institute and to those of the provincial research officers.

I. Soils.

Survey of soils. In BIHAR AND ORISSA, a soil survey of the Saran District has spotted an extensive tract of poor land in the Gopalgunj Sub-division which seems capable of improvement by judicious manuring. Its poverty is probably due to the fact that it is not enriched by silt deposits; on the other hand, the finer soil particles are washed away. A survey of the Gaya and Patna Districts is now in progress.

A soil survey of North Malabar in MADRAS has shown that about 90 per cent. of the soils in the district are deficient in nitrogen and phosphoric acid.

A systematic analysis of the soils of Akyab in BURMA has revealed its unsuitability for coconut growing on account of deficiency of potash and nitrogen. A beginning has been made with a soil survey of the Pegu Division.

The scientific staff of the INDIAN TEA ASSOCIATION has completed the soil survey of South Sylhet, Dhunsiri and Nowgong; the results have been published.

Soil acidity. In BENGAL, a study of the problem of soil acidity is in progress. A large number of comparative figures of soil hydrogen-ion determinations covering most of the representative soils of the province has been obtained, and this work is now being linked up with the availability experiments. At Jorhat in ASSAM, the acidity and hydrogen-ion concentration of plots under different manurial treatments is under examination, and the officers of the TEA ASSOCIATION are studying the same subject with reference to tea soils. Tea, unlike most crops, has been found to require a soil of fairly high acidity. This conclusion is confirmed by field experiments in which the lowering of the acidity of the soil by liming was nearly always followed by a definite loss of crop.

Soil drainage. A review of the results obtained at the Cawnpore drain-gauges during the years 1910-1923, has been accepted for publication as a Pusa Memoir. It appears that the heavier the rainfall, the greater the drainage and loss of nitrogen. Cropping reduces the drainage considerably, and the heavier the crop the less the drainage. Fallow land loses about seven times more nitrogen in the drainage water than cropped land.

Soil moisture. In the BOMBAY Deccan and Gujarat, there are large areas where the rainfall is precarious and irregular and where the amount of irrigation must always be small. The conservation of soil moisture is consequently the predominant factor in crop production. Investigations are, therefore, being carried out with a view to determining the physical properties of these soils and to investigating ways and means of increasing their water-holding capacity. A very considerable increase in the retentive capacity of the soil has been obtained by green-

manuring, and the Soil Physicist is now trying to discover the best method of applying this knowledge.

At PUSA, the adsorption of water by soils, when exposed to a moist atmosphere, has been found to depend on the amount of clay they contained; the relation being capable of being formulated as a log-log curve. The influence of temperature on the constants of the equation is being investigated.

Soil aeration. In a sticky soil at Surat in the Bombay Presidency, cotton was found to thrive much better on ridges than on flat land. The superior condition of the crop grown on ridges was presumably due to the better conditions thus obtained for aeration and nitrification.

The "available" phosphoric acid in soil. The potassium carbonate method of estimating the amount of available phosphoric acid, which has been found so useful at Pusa in the case of calcareous soils, has been extended to other types of soil. The analytical figures obtained during the year with acid soils from Assam and Burma, laterite soils from Bengal and non-calcareous soils from Madras served to differentiate between manured and unmanured plots, and compared well with those given by Dyer's citric acid process. It is proposed to apply this new method to other soils of known manurial and cropping history.

Movements of nitrates. The study of the movements of nitrates in the soil and the sub-soil at Pusa, has been extended to four areas treated as pasture, fallow, unirrigated cropped land and cultivated land receiving irrigation. The observations made during the year indicate that the distribution of nitrates in the soil, besides being regulated by rainfall and the nature of the sub-soil, is profoundly modified by the growth of crops and the cultural operations which the field receives.

II. Nitrogen Fixation.

The work on nitrogen fixation in soil by non-symbiotic organisms at PUSA was extended to algæ, and it was ascertained that fixation of nitrogen by algæ alone can take place in India in liquid culture media. The considerable increase of fixation

shown in soils exposed to light, as compared with darkened controls, accompanied with a correspondingly large growth of algæ, strongly suggests the independent action of the latter in this respect. Further experiments on symbiotic action between algæ and azotobacter confirmed the conclusions of the previous year that such action enhances the amount of fixation.

The effect upon the multiplication of azotobacter of various nutrients in culture was also studied; of all the substances tried mannite gave the greatest increase in growth and peptone the least. The rate of nitrogen fixation varied greatly between different soils. Soil from Karnal in the Punjab was found to give high rates as compared with Pusa arable soil; while a soil from Burma afforded an interesting example of the lime requirements of azotobacter.

Experiments designed to ascertain whether and under what conditions an ordinary DECCAN soil, taken at the end of the hot weather and kept dry, would fix nitrogen from the air, have reached a stage at which the preliminary results can be published. To begin with, it was decided to investigate the effect on the nitrogen of the soil of varying quantities of moisture, and of varying temperature and light conditions, and the effect of additional lime in each of these cases. It has been ascertained that up to 30 per cent. of moisture, the larger the quantity of water the higher is the amount of nitrogen fixed; that fixation and nitrification are higher at 40°C. than at lower temperatures; and that an increase in nitrogen takes place both in the presence and absence of light. When a moistened soil was dried after fixing the highest quantity of nitrogen and then moistened again, the amount of nitrogen fixed increased for four or five weeks more, up to a certain limit. The addition of lime to a soil already containing enough lime did not show any advantage over the control in increased nitrogen fixation, but it facilitated nitrification.

III. Manures and Fertilizers.

Organic manures. The utilization of the activities of sulphur-oxidizing bacteria is being directed at PUSA to the

conservation of nitrogen derived from urine. It has been found that the loss of nitrogen as ammonia during the fermentation of urine can be prevented by the addition of sulphur and appropriate oxidizing bacteria, the ammonium sulphate formed being readily available as a nitrifiable source of nitrogen. Experiments to determine the economic value of this method are being carried out.

In MADRAS, sulphur was found to be the most effective of the various chemicals tried for inhibiting the loss of nitrogen from farmyard manure. Further experiments on a large scale confirmed the results obtained in the previous year, namely, that the box system of storing farmyard manure, in which the manure is compacted by the animals themselves, is the best so far as the quantity, quality and cropping value of the manure are concerned. The possibilities of producing artificial farmyard manure by fermenting organic matter are also being investigated. When cattle dung was used to supply the starter nitrogen, there was no loss of nitrogen from the waste material used. The relative availability of different organic manures in South Indian soils is being studied. Laboratory experiments have shown that as a rule nitrification in black cotton soil is greater than in red soil. Judging from the yield in pot-cultures, groundnut cake with or without phosphates gives the best results of all, and is even distinctly superior to ammonium sulphate with or without phosphates.

In BENGAL, experiments are being carried out with a view to ascertaining the progress and limit of nitrification in red soils treated with oil-cake with or without the addition of lime. With lime a depression of nitrification occurs in the beginning which continues for three weeks, after which nitrification progresses more rapidly in limed than in unlimed soils. After the lapse of about 12 weeks nearly 75 per cent. of added nitrogen is nitrified in limed soils, while the corresponding figure is 25 per cent. only in unlimed soils.

It has been found at PUSA that the loss of nitrogen as ammonia during the preliminary stages of decomposition of bonemeal in the soil and in composts could be prevented by the

addition of sulphur in the presence of appropriate oxidizing bacteria. Pot-culture experiments in MADRAS have demonstrated the superior value of the small amount of nitrogen in bonemeal. When ignited bones were used in the place of bonemeal, the yields of both straw and grain were reduced to a fourth of the normal yield. The practice of igniting and powdering the bones, which is followed in certain places owing to the lack of facilities for preparing the meal, greatly reduces their manurial value.

Phosphates. A successful method of preparing dicalcic phosphate from apatite has been worked out in the Chemical Section at PUSA. This phosphate is found in large quantities in parts of Bihar. The process involves the solution of the mineral in perchloric acid and the subsequent precipitation of the dissolved phosphoric acid as lime phosphate. The latter contains about 35 per cent. phosphoric acid, as against 41·27 theoretically present in dicalcic phosphate. Almost the whole of this phosphoric acid is citrate-soluble; it is available to plants, and in certain types of soils, the manurial value of the phosphate should be equal to that of superphosphate. The importance of this electrical process is due to the fact that it eliminates the use of sulphuric acid, the high price of which has hitherto stood in the way of the manufacture of superphosphate from deposits of apatite available in India.

Further experiments carried out during the year in the Bacteriological Section have shown that by means of composting with sulphur the natural indigenous phosphate in the form of bones can be effectively utilized in place of imported superphosphate. The addition of a small quantity of charcoal to the compost has been found to enhance the solubilization, this being probably due to the effect on the oxygen supply.

In MADRAS, superphosphate when used alone was found to have a depressing effect on the yield, but trials with Trichinopoly phosphate and Tetra phosphate gave encouraging results.

Calcium cyanamide. Pot experiments carried out in MADRAS with cyanamide and farmyard manure individually and in combination, have shown that cyanamide alone gives as good

results as when used in conjunction with organic manures, the yields in both cases being five times those obtained in the pots used as controls. Successive and increasing doses of cyanamide on a clayey soil, however, result in a gradual decrease in the yield of grain and an increase in the yield of straw.

Gypsum. Experiments with a strain of *mung* (*Phaseolus mungo*) at Sabour indicate the usefulness of the application of sulphates, especially gypsum, to the monsoon crops in South BIHAR. In all the plots to which sulphates were applied the growth of healthy plants was distinctly more vigorous than in those treated with other salts, gypsum giving the most favourable result.

Lime. The investigation dealing with the application of lime and bones to the red laterite soils of BENGAL, referred to in last year's report, has practically been completed, and the results are being collated for publication.

In MADRAS, when lime was applied either as oxide or carbonate to a crop of *ragi* (*E. coracana*) the yield of both grain and straw was depressed. The addition of a small quantity of potash, however, resulted in normal yields being obtained.

Manurial experiments on the Jorhat farm in ASSAM have proved that wood ash when applied with cowdung is a good alternative to lime as an ameliorant of soil acidity. It has the additional advantage of being cheaper and easily available for the common cultivators of the province.

Influence of manures on quality of crops. Since 1920, a series of nine plots having the following manurial treatment are cropped at Pusa in the *kharif* with *marua* (*E. coracana*) and in the *rabi* with oats and wheat to ascertain the influence of different plant foods on the composition of the resulting produce: (1) no manure, (2) oil-cake, (3) nitrogen, phosphate and potash, (4) nitrogen and phosphate, (5) nitrogen and potash, (6) phosphate and potash, (7) nitrogen, (8) phosphate and (9) potash. It is yet too early to formulate authoritatively definite conclusions on the original object of the investigation, but the nature of the yields from different plots provides interesting indications. Of the three plant foods used, the effect of

nitrogen has been very marked; there has been also a response to phosphate, but potash has seldom increased the yield. Of all combinations, the application of oil-cake has given the highest yield.

IV. Sugarcane.

Experiments on the windrowing of sugarcane under PUSA conditions were continued. The quality of sugarcane windrowed in the shade for 28 days was as good at the end of that time as cane which had been left standing : the windrowed cane not only retained its quality as regards juice, but germinated well when planted. It was ascertained that setts of both fresh and windrowed canes germinated more quickly when soaked in water before being planted. The discovery of a successful method of obtaining quick and uniform germination after planting would be of great advantage to cane-growers. Slow and irregular germination in tracts where cane is grown without irrigation as in Bihar, results in the growth of the crop being seriously retarded by the dry hot winds. The crop when well advanced before the hot weather sets in fares much better.

At Sabour in BIHAR periodical analyses of the juice of the Saretha cane which came into flower in November were made with a view to finding out whether flowering was a sign of deterioration of the cane, as generally supposed. It was found that the canes in flower were actually richer in sucrose content, and that the yield of juice was not appreciably lower than that obtained from canes not yet in flower.

V. Sugar-beet.

Further trials with sugar-beet at PUSA have indicated that it would be possible to produce beet of good quality from the middle of March, when sugarcane ceases to be available, to the middle of May. If the sowing of beet is delayed until the end of November, the period can be extended by at least another fortnight. The outturn from different plots varied from 10·3 to 12·5 tons per acre, and the calculated amount of sucrose amounted to 1·79 tons per acre.

VI. Losses in Sugar Mills.

A successful trial was made in certain sugar mills during the last working season of the use of electrolytic chlorogen (E. C.) manufactured at PUSA, for reducing bacterial fermentation of the juice and the formation of invert sugar resulting therefrom. The method will hereafter be systematically adopted in practically all the factories in North Bihar.

VII. Animal Nutrition.

Feeding experiments were carried out at BANGALORE with the cattle foodstuffs in use at the dairy. In one of these experiments two lots of 6 heifers each were fed with varying amounts of roughage and concentrates for a period of 100 days; four cross-bred Holsteins clearly excelled all others in their capacity for consuming roughage and adding to their weight. Interesting results were obtained in an experiment designed to determine the cost of milk production in the case of cross-bred cows. The data obtained show that per pound of milk produced these cattle used the same amount of total nutrients as the American cows tested by Haecker, but required slightly more net energy per pound of milk. The experiment has been extended to a pure Indian breed—the Scindi. The study of nitrogen metabolism of Indian cattle and the determination of maintenance rations were continued. The Physiological Chemist prepared during the year detailed schemes of work on animal nutrition for the Madras and Mysore Departments of Agriculture.

VIII. Milk.

A systematic analysis of the milk of selected cows of the Pusa herd showed a gradual rise in the fat content with the progress of the lactation period. The milk having the highest fat content (6·5 per cent. average) was yielded by a Montgomery cow.

Plate counts of the bacteria in the Pusa dairy milk supply during the last two years have shown a wide variation at different periods due to the differences in the character of the seasons. It was, however, clear that the production of milk with a con-

tent of bacteria falling well within the limits allowed for Grade A milk in England demanded only ordinary precautions, such as the use of covered milking pails and the thorough steaming of pails, cans, etc., and that milk bacteriologically of certified standard could, with somewhat greater care, be produced.

IX. Effect of Grass on Fruit Trees.

The results of experiments carried out at PUSA on the effect of grass on trees have been published. Mr. Howard investigated in great detail the form, and distribution in the soil, of the root system of eight species of fruit trees, and found generally that the effect of a grass covering was to restrict the development of the superficial root system. On this root system the plant depends for the absorption of food material from the soil during the monsoon when the deeper seated portion of the root system is largely inactive owing to the waterlogged condition of the sub-soil. The harmful effect of a grass covering on the surface root system appears to be due to the fact that, under grass, the percentage of carbon dioxide in the soil gases is much higher than is the case under clean cultivation. This, however, does not explain the entire problem of the harmful effect of grass on trees, as the artificial aeration of the root system of trees under grass only leads to a partial abatement of the symptoms of malnutrition. The starved appearance of trees under grass, the reduction in size and the yellow colour of the leaves, all suggest a deficiency of combined nitrogen. From the results of chemical analysis the author concludes that the amount of nitric nitrogen in the top layers of the soil under a grass carpet is only from 10 to 20 per cent. of that met with under cultivation. The presence of a soil toxin produced by the grass would, however, explain the results and has indeed been suggested by previous workers. This was investigated by applying heavy doses of nitrogenous manure to the guava trees which were under grass. The guava differs from the other fruit trees included in these experiments, in that its superficial root system is not affected by a grass covering, and the whole of the harmful effect

of such a covering in the case of this species is to be attributed therefore to the deficiency of nitrogen. The results left no doubt that manuring the trees under grass with a nitrogenous manure such as sulphate of ammonia, would entirely remove the harmful effect of the grass. The fact that the addition of nitrogen in these cases led to more growth than under cultivation showed that no additional adverse factor such as a soil toxin was involved.

The behaviour of certain forest trees under grass was also investigated, and it was found that the character which distinguishes forest trees from fruit trees appears to be the power possessed by the surface roots of the former of resisting the harmful effects of an atmosphere rich in carbon dioxide.

X. Water Hyacinth.

Further experimental work done in BENGAL to determine the effect of sprays on the water-hyacinth has demonstrated that Griffith's spray is effective in killing 75 to 90 per cent. of the plants in a treated area, and that spraying is less expensive than man-handling. The spray being a poison there is, however, some danger in using it in areas adjacent to dense centres of population. The results of a series of experiments at the Institute of Plant Industry, INDORE, on the conversion of a water weed into finely divided organic matter suitable for the cotton crop, have induced Mr. Howard to suggest that the water-hyacinth should no longer be regarded as a pest to be destroyed, but should be converted into valuable manure for jute and rice by means of the Chinese methods of composting crop residues.

XI. The Lavala Weed.

The research financed by the Sassoon David Trust Fund, to find a means of eradicating the lavala weed (*Cyperus rotundus*) which is easily the worst weed of cultivated land in Western India, has given conclusive results, which have been published as a Pusa Memoir (Bot. Series, Vol. XIII, No. 5). These methods are now being experimented with on a large scale.

XII. Diseases of Crops.

The practical methods adopted for combating the ravages of diseases attacking the more important crops have been indicated in the previous chapter. It is proposed to deal here with such investigations as have not yet reached the stage of practical application.

At PUSA, further progress was made in elucidating the factors affecting the pigeon-pea wilt problem and in interpreting the data obtained from the existing field experiments. Special plots laid down during the year show that green-manure does not neutralize the presumed effect of superphosphate to the same extent as appears in the permanent manurial series. Estimations of moisture carried out in all the latter plots to a depth of two feet dispose of the theory often advanced that the highly wilted plants are waterlogged. The wilt diseases of gram and linseed are also under study.

An investigation has been started on a new disease reported from Lower Burma as being the cause of the death of young cinchona plants. The preliminary observations made indicate that neither fungi nor bacteria are responsible for the symptoms which are probably physiological. The indications are that a disturbance in nutrition due to the plants being grown at too low an elevation in an environment which they can with difficulty tolerate, causes the least adaptable to succumb.

An outbreak of a disease resembling collar rot, mosaic or yellow-stripe and chlorosis among the Coimbatore sugarcane varieties introduced in North Bihar suggested a survey of the disease in the country with a view to finding out which varieties are susceptible to it. A careful examination of fresh material has revealed the presence of mosaic in cane plots on the agricultural stations at Pusa and Sabour in Bihar; at Aligarh, Kalai and Bulandshahr in the United Provinces; at Gurdaspur in the Punjab; at Coimbatore, Palur and Samalkota in Madras; and at Manjri in Bombay. Among the canes carrying disease were noticed a few of the Coimbatore seedlings as well as such popular canes as Red Mauritius, Purple Mauritius,

Fiji B and Hemja; a considerable number of Coimbatore varieties had no mosaic markings whatsoever. Of the Coimbatore canes in general cultivation, Co. 210 and Co. 213 have only 5 per cent. of clumps infected, while Co. 214 is believed to be quite free. On the other hand, the local Hemja is heavily infected throughout North Bihar. It appears that the disease has existed among the thin canes of Northern India for a long time, and now that it is known to be present, considerable attention will be paid by the department to all the new varieties, particularly those of the Coimbatore series, for possible tolerance and resistance.

The work on the *Helminthosporium* group of diseases was confined chiefly to a morphological and physiological study of a species found on ginger. Inoculations and cross-inoculations were carried on with all the six strains of *Pythium* isolated from various cucurbitaceæ plants to determine their parasitic nature, and it was found that they readily infect their host plant and each other. A comparative study of *Phytophthora Faberi, P. palmivora and P. Meadii* has been commenced with a view to ascertaining whether these three species are identical or different strains of one species.

A boll rot caused by a species of *Vermicularia* and found for the first time on *herbaceum* cottons at Coimbatore is being investigated in MADRAS. Many of the affected bolls do not open, the lint is yellow and the fungus is found permeating the fibres. A series of experiments laid down to determine the methods of transmission of the leaf-shedding disease of sorghum has proved that one of the methods of infection is through diseased leaves left in the soil.

The storage rots of potatoes, cotton wilt, cotton boll-shedding and the Katte disease of cardamom are the principal subjects of investigations in BOMBAY. Preliminary trials indicate that the very large losses of potatoes which take place during the rains can be rendered negligible by keeping them in a dark room under cold storage conditions at a temperature of 36°F. to 40°F. Types of Kumpta cotton have been bred at Dharwar which seem almost immune to wilt, while the data collected at

Surat has considerably narrowed down the problem of boll-shedding. It has been ascertained that the Katte disease is caused by a protozoa parasite in the soil which can easily be destroyed.

In the CENTRAL PROVINCES, the fungus isolated in a pure state from wilted cotton plants again failed to infect healthy plants. It was also observed that wilted plants show internally the same characterization as mature plants do when they are reaching the end of their season's life. Experiments dealing with foot rot in wheat have led to the tentative conclusion that the early sowing of wheat in the Nagpur District tends to render the plants more susceptible to the disease.

The Plant Pathologist in the UNITED PROVINCES is concentrating on the investigation of storage rots of potatoes. With a view to installing a cold storage plant, he carried out during the year tests with the heat-resisting properties of various insulating materials available in the country.

XIII. Insect Pests.

The measures adopted against important pests of field and garden crops have been referred to elsewhere and need no recapitulation. A large number of useful observations relating both to the behaviour of insects known to affect crops and to their parasites, has been made at Pusa and in the provinces. These are referred to below.

At PUSA, *Aphis sacchari* was noted for the first time in fairly large numbers on sugarcane, and *Eretmocera impactella*, normally a pest of *Amaranthus* spp., was found in fairly large numbers on beet. A report regarding a caterpillar pest on coconut (*Thosea unifascia*) was received from the Andamans; the pest was investigated on the spot. The remedial measures carried out involved the cutting and burning of the leaves affected by caterpillars, the destruction of cocoons, and the capture of moths by light traps. Work was continued on the life-histories and structure of the local species of Tabanidæ. *Chrysomyia bezziana* was reared successfully (for the first time,

it is believed) on meat, from young larvæ extracted from a malignant growth on the heel of a patient in the Pusa hospital.

The study of the bionomics and control of the pink bollworm (*Platyedra gossypiella*) of cotton, the paddy stem weevil (*Schœnobius incertellus*), the sorghum fly (*Calocoris angustus*) and fruit moths (*Ophideres* spp.) was continued in Madras. The efforts to check the ravages of *Nephantis serinopa* on coconuts by the introduction of parasites are meeting with an encouraging measure of success.

In the CENTRAL PROVINCES it has been ascertained that, by chaffing sorghum *kadbi* in a fodder cutter, the number of resting larvæ of the sorghum borer is reduced by about 50 per cent. This method of preparing cattle food, which has for long been recommended by the department, thus offers an advantage other than that generally attributed to it of effecting an economy in fodder.

The investigation of the pink bollworm attack, which is responsible for the loss of 20-40 per cent. of the cotton crop in the UNITED PROVINCES, continued to be the main work of the Provincial Entomologist. Initial trials with seed heated to a temperature of 140° F. for a few minutes before sowing have indicated that this method of seed treatment may prove a cheap and easy method of dealing with one of our most serious cotton pests.

In the PUNJAB, a careful study has been made of the red pumpkin beetle (*Aulacophora abdominalis*) which has proved a serious menace to the cultivated cucurbits. In dealing with this pest it is recommended that a few early plants be grown to serve as a trap crop. The beetles on coming out of hibernation are attracted to these and can then be killed by the use of a stomach or contact poison. By ploughing the fields, after the spring crop has been harvested, the larvæ and pupæ are exposed to the sun and are readily picked up by birds.

XIII. Useful Insects.

Bees. The Entomological Section at PUSA continued to deal with enquiries relating to apiculture and to supply im-

proved hives, foundation combs, etc. There is a rapidly growing demand for a suitable variety of bees.

Lac. Observations on the lac-insect and its parasites were continued at Pusa, particular attention being paid to the seasonal appearance of, and extent of parasitization by, the Noctuid moth (*Eublemma amabilis*) which is responsible for considerable damage in lac plantations. Demands for brood-lac could not all be met from the limited resources of Pusa. It is, however, expected that the Indian Lac Association for Research, which has established research laboratories at Ranchi, will shortly take up the work of maintaining a good supply of brood-lac for distribution.

Silkworms. The BENGAL department maintains 11 nurseries for rearing silkworms. The one at Kurseong is being utilized for the Chotopolu which is a delicate race, while the breeding work on the Nistari, which is less susceptible to disease, is carried on at Alipur. Of the remaining nine, one is used for the production of pure strains of Chotopolu, one for rearing eri worms, and seven for supplying disease-free seed of the Nistari to professional rearers. The sales from these nurseries amounted to Rs. 75,275 as against Rs. 75,230 in the previous year. In addition, a large quantity of disease-free cocoons was issued to private seed farms of selected rearers. The latter produced as many as 15,000 kahans of seed, and thus doubled the quantity of pure seed available for distribution. The sericultural schools at Rajshahi and Berhampore continued to train the sons of rearers in improved sericultural practice. At Rajshahi, five out of 11 students passed the final examination.

In BIHAR AND ORISSA and MADRAS, the Department of Industries, which is in charge of sericultural work, is supplying disease-free seed and testing methods of reeling silk.

In the Punjab, 1,496 oz. of silk seed was distributed among 1,092 rearers. With a view to helping the growers to obtain a fair price for their produce, Government has started a filature at Sujanpur which is working at a profit. Nearly 7,000 new mulberry seedlings were planted on canal banks, and 13,000 were distributed among private persons and schools.

Rearing was carried on with the indigenous Taungle race in Burma, and altogether 530 layings of eggs and 2,450 seed cocoons were supplied to rearers. Experiments were also continued with univoltine races imported from Japan and Kashmir. Of the four hybrids still under trial, one known as the Nistari hybrid is the most promising.

Nearly 4 lakhs of layings issued from Government grainages in Mysore represented an increase of 60 per cent. over the figure of the previous year. Moreover, the selected rearers working under departmental control produced about 7½ millions of seed cocoons for distribution throughout the State. The experimental work on the rearing of a more efficient race of silkworm indicates that the F_1 generation from a pure foreign race is 100 per cent. superior to the local worm in silk yield and its period of rearing is less by four days.

CHAPTER IV.

AGRICULTURAL ENGINEERING.

Of the area of nearly 48 million acres irrigated in India, over half is commanded by Government and private canals and the rest by wells and tanks The improvement of the efficiency of the latter by subartesian bores and the installation of power pumping plants forms one of the chief planks in the programme of the engineering sections of the Agricultural Department. During the short period of its existence, the department has been instrumental in increasing the capacity of thousands of existing wells and in digging or sinking an equally large number of wells (Appendix III, p. 128). The substitution of power pumps for water-lifts driven by bullock or man power is not so simple, as capital or at least credit will have to be forthcoming for its fulfilment.

The designing and testing of agricultural implements is another important activity of the engineering sections. Several types of very efficient ploughs which are at present on the market owe their design to the agricultural experts of the department working in collaboration with the trained engineers of certain firms. As will be gathered from the figures given in Appendix IV (p. 129), a large demand for improved ploughs has been created, and the department is doing all in its power to foster and stimulate that demand. In addition to the sales effected through departmental agencies, a considerable private trade in these implements is gradually growing up. India still needs efficient types of drills, mowing machines, fodder cutters, threshers, winnowing machines and cane mills suitable as regards the cost and draught power required. It is, however, hoped that some of the promising designs evolved by the newly appointed Agricultural Engineers and now under trial will meet the needs of the Indian cultivator.

There is a big demand for the use of the boring machines of the **Bombay** department. During the year under report, 104 successful bores were made. The land development work started by the department promises to be of great value. The two

designs of implements which have reached a practical stage are a modification of the Orient plough suitable for Sind and a modified plough share for the improved iron plough now used in large numbers in black soil areas.

In the **United Provinces,** 101 enquiries for tube wells were received and examined; 23 wells were completed and 34 were under construction at the close of the year. Eighty per cent. of the tube wells constructed in recent years are situated in eight of the 45 districts of the plains; steps are being taken to introduce them in others where they are less known. Of the 656 shallow borings made, 447 or 68 per cent. were successful.

In the **Punjab,** 238 bores were sunk during the year, of which 188 were successful. The Agricultural Engineer has devised a new system of reinforced concrete construction which results in a saving of 15-30 per cent. in the capital cost as compared with the method at present in practice.

In **Bihar and Orissa,** two tube wells fitted with strainer tubes were completed, 120 new bores were sunk and 48 old borings were cleaned and relined. The success of the $8\frac{1}{2}''$ tube well delivering 12,000 gallons of water per hour has opened up a new field of operations for which a fair demand is anticipated from cultivators and zemindars of limited means. The nine-geared bullock-power bucket-pumps known as " rayat pumps " installed during the year have been found suitable for irrigating areas up to 10 acres. The improved McGlashan *gur*-boiling furnace has been tested and found very efficient.

The Agricultural Engineer in the **Central Provinces** has designed two new implements, *viz.*, a reversible blade *bakhar* and a grubber for clearing the land of sorghum and cotton stalks. Two other implements designed, namely, a clod crusher and a winnower, are under trial. The boring equipment formerly maintained by the department has been handed over to the Public Works Department.

Three types of seed-drills, a sub-soil plough, a grain winnowing machine and a high lift-water elevator designed during the year are under trial in **Burma.** Thirty-nine screw water-lifts designed in the previous year were sent to the districts.

The post of Agricultural Engineer in **Madras** having remained vacant throughout the year, no progress was made in designing new implements. Four hundred and thirty-three wells were successfully bored by the Industries Department to whom this work is now entrusted.

The **Mysore** plough which is believed to mark a distinct advance in the adaptation of improved implements to Indian conditions, is being used in large numbers in the State. The newly organized boring section executed 16 borings and 4 blastings.

The Alwaye and Pallikkal ploughs designed by the **Travancore** department are reported to be popular.

Out of 16 bores sunk during the year in the **Hyderabad** State, eight were successful.

During the last five years **motor tractors** have been tried in different parts of India. The general opinion is that they are useful for two purposes, namely, (1) for light and shallow cultivation on large estates when a considerable area of land has to be cultivated in the shortest possible time, and (2) for clearing lands infested with persistent weeds. They are being used, too, for stationary work; but when employed for such work are less economical than an oil-engine. The types of tractors tested up to date are not sufficiently powerful for ploughing where the soil is very heavy and weedy. They are not sufficiently fool-proof either; it is very difficult to keep them in good running order, as first class mechanics are not easily obtainable and spare parts are not always available in the country. Still the fact remains that with intelligent use the tractor is a farm-power unit of considerable possibilities in tracts where the draught power at present available is inadequate and where, in the absence of any other form of mechanical power, it is impossible for the agriculturist to perform his tillage operations under optimum conditions.

It is held by engineers well acquainted with agricultural conditions in India that the development of agriculture is likely to be of a very restricted character in this country unless it connotes the application of the resources of mechanical engineering to the

tilling of the soil, the supply of irrigation water, the harvesting of the crops, their transport to factories and to the machinery for converting them into finished or at any rate easily marketable products. It is beginning to be realized that in the application of engineering to agriculture there lies a field open to immediate exploitation; but to achieve results commensurate with the interests involved, standardization of plant is very necessary. India pays dearly, as pointed out by Sir Alfred Chatterton, for the privilege of being able to select its agricultural machinery from the numerous competitive types imported from abroad.

In India we are now at the transition stage between manual and mechanical power on the farm. A beginning has been made in substituting steam and internal combustion engines, and in introducing implements and machines worked by bullocks. The relatively low standard of cultivation attained in India is largely the result of the inefficiency of the country (*desi*) plough; this plough, inefficient though it is, is used for several operations for each of which special implements have been invented in more advanced countries. The improved iron ploughs now being used in India are the handiwork of engineers who have devoted much time and thought to their evolution. The exact relationship of their different parts to the work which they have to do has been thoroughly studied, with the result that we have to-day various types of improved iron ploughs in use which are wellnigh perfect. The chief handicap in the way of introducing them on a large scale is that the bullocks which supply the motive power are, over a great part of India, somewhat weak and small; still an ever-increasing demand for such ploughs has already been created. That demand is likely to grow, for there are millions of acres of weedy land in India which year after year give poor yields owing to its being infested with *kans* or other persistent weeds which rob the crop of much of its plant food and moisture. There are, moreover, hundreds of thousands of acres of good land lying fallow because these weeds have overrun the fields. This weed can be eradicated by means of iron ploughs worked by strong pairs of bullocks or buffaloes; but the number of these is limited. For such tracts there is little doubt but that there is

an opening for the use of steam ploughs and perhaps motor tractors. At the present time there are in India about 40 sets of steam tackle worked on the cable system.

There is already a fairly large demand in India for iron cane mills and some demand for power pumps, winnowers, reaping machines, fodder cutters, threshers, hoes and harrows. There is a growing demand, too, for pig-proof fencing; for both wild and domesticated animals do an enormous damage every year to the village crops.

When the landed aristocracy of India wakes up to a sense of their responsibilities, the demand for improved hand and power appliances for the better cultivation of the land will be enormous: the annual demand for ploughs alone may run into hundreds of thousands. To foster and stimulate the demand the Department of Agriculture is doing its utmost. It is demonstrating the working of approved implements and machines in the villages. It displays them at agricultural shows and ploughing matches. It stocks them for sale and in some cases for hire at depôts on Government farms. It is organizing their sale through co-operative societies, and in some provinces it is giving pecuniary assistance in the shape of *taccavi* for their purchase. More than this it cannot do at present; for its staff is small and its activities extend over a very wide field of which the introduction of labour-saving implements forms but a small part.

CHAPTER V.

DISTRICT WORK.

The extension work being carried out by Departments of Agriculture in the provinces and Indian States is increasing year by year. The organization for this work now embraces the activities of thousands of co-operative societies, agricultural associations, private seed farms, demonstration plots, etc. These are supplemented by agricultural shows, lectures illustrated by lantern slides, ploughing matches, and the distribution of popular literature dealing with improved methods of husbandry generally.

The results have been highly gratifying, despite the fact that departments have been handicapped by the paucity of staff and lack of funds. Reference has already been made to the millions of acres now sown with improved crop varieties: twenty years ago the acreage sown could not have exceeded as many thousands. The demand for agricultural implements and manures, though it has not increased to the same extent perhaps, is now a very real one. A private trade in both has sprung up and the turn-over is increasing every year. Though only a part of the demand is being met by Agricultural Departments, these supplied 29,414 improved implements and 14,262 spare parts last year. The demand for spares gives some indication of the extent to which these new implements are being used.

The demand for artificial manures is also growing; one Calcutta firm supplied 25,000 tons last year, excluding oil-cakes. In 1914 the same firm sold about 2,000 tons only. Sulphate of ammonia as a manure for sugarcane is making headway in Western India; approximately 5,000 tons are now applied to this crop every year and the prospects of a steady increase are reported to be very good. As a manure for cotton both sulphate of ammonia and nitrate of soda are already being used on a small scale, and the indications are that for this crop, too, the demand is likely to increase in the near future. The ever-in-

creasing demand for oil-cakes ordinarily used as manures has forced up prices to such an extent that in most parts of India oil-cake per unit of nitrogen now costs more than some of the other nitrogenous fertilizers on the market. This is due to the fact that the supply of oil-cakes available is strictly limited, while that of sulphate of ammonia, nitrate of soda and calcium cyanamide is almost unlimited. If the sale of the latter were properly organized by the trade, the demand would increase even more rapidly than it is doing.

In the **Bombay Presidency,** propaganda and extension work are being directed by Divisional Boards of Agriculture which are predominantly non-official. These boards work through 48 taluq development associations subsidized by Government. During the year under report, they were actively engaged in extending the use of improved implements, cotton seed, wheat and other agricultural produce, and methods for the prevention of smut in *juar* and of other diseases. They have organized shows, pushed the formation of co-operative societies for the sale of produce or the purchase of seed, and in one case at least initiated a promising system of fodder storage. These bodies have thus proved to be of considerable potential value in providing a local agency for introducing improvements recommended by the department. The department continues to supply them with improved seed and with implements and manures in certain cases. For the supply of seed, the department controls large areas in selected parts of the presidency. The most elaborate organization for seed distribution is to be found in Lower Gujarat where the quantity of cotton seed distributed amounted to 2,164,000 lb. The Government zemindari maintained in Sind for producing cotton seed supplied 120,000 lb. of seed and earned a profit of Rs. 12,560. The depôts for the sale of implements are gradually being transferred to the control of local bodies, preferably co-operative implement societies or taluq development associations.

An increasingly close *liaison* between the Agricultural and Co-operative Departments in district work is also reported from **Madras.** District federations of co-operative unions, which are

in course of organization in most districts, will, it is anticipated, take a real interest and play a definite part in agricultural propaganda in future. As in previous years, the department distributed a large quantity of improved seed. The use of green manures for wet land occupies a prominent place in the extension work of the department; nearly 110 tons of sann-hemp, *dhaincha* (*Sesbania aculeata*) and wild indigo seed were sold to cultivators during the year under review. Artificial manures such as bone-meal, fish guano and superphosphate are also gradually coming into popular favour; in addition to the 370 tons sold by the department, a large trade in these manures was done by private firms. A systematic campaign conducted in cane growing areas resulted in the erection of 326 McGlashan *gur*-boiling furnaces, each of which is calculated to add as much as Rs. 90 per acre to the net profit on cane cultivation. The spraying of garden crops against various diseases and the use of copper sulphate as a preventive against sorghum smut are other lines of work which have appealed to the cultivators. Machines capable of spraying 600,000 areca-nut trees were sold in South Malabar alone.

A portion of each Government farm in **Bengal** is now being run on an economic basis to demonstrate the advantages to be gained by using improved seed and by adopting improved methods of cultivation. Similarly several farms established as commercial propositions by leading zemindars and Khas Mahal and Court of Wards estates serve as effective demonstrations for improvements recommended by the department. In Northern Bengal alone, there are now 40 areas which are more or less devoted to the production and distribution of departmentally improved seed. During the year under review, 66 tons of jute seed were sold and over one ton distributed in small packets from Government depôts. The insistent demand for paddy seed is being met by forming small village associations for growing paddies recommended by the department. Eight such centres have already been created in the Dacca District.

In **Bihar and Orissa**, co-operative central banks and rural co-operative societies are rendering increasing assistance in the

spread of Dahia paddy, groundnuts, Pusa wheats, Coimbatore sugarcanes, Kakya Bombai jute, and artificial manures tested and approved by the department. Demonstrations of green-manuring in combination with superphosphate in the paddy fields of the Bhagalpur Circle resulted in a net profit of Rs. 15-30 per acre, while the applications of castor cake and ammonium sulphate to the potato crop showed in one instance a net gain of Rs. 242 per acre. As the result of departmental propaganda, there is now a considerable demand for gypsum in the Patna Circle; over 130 tons of this manure were imported from Bikanir for distribution among cultivators.

If any proof were needed of the soundness of the agencies employed for propaganda by the **United Provinces** department, it is to be found in the financial results of its seed and demonstration farms and demonstration plots. Fifteen farms of the former class earned a profit of Rs. 33,000 on an outlay of Rs. 1,20,000, while 5 plots of the latter category had a return of Rs. 11,000 against an expenditure of Rs. 8,000. Public confidence in the value and possibilities of improved methods of cultivation has been largely gained by such striking results, and the evidence of this is forthcoming in the increase in the number of landowners who are cultivating their own land by methods demonstrated on the departmental farms. The number of these private farms increased by 99, and is now 504. Of these, 58 are each of 100 acres and over, and 124 of 50-100 acres. The best results were obtained from three farms of 60 acres each, which reported profits of Rs. 6,243, Rs. 4,135 and Rs. 4,067, respectively. They serve not only as seed depôts, but also as centres from which improved methods spread to surrounding cultivators. There was also a satisfactory increase in the number of demonstrations carried out in the villages. From the 98 stores run for the purpose, 2,537 tons of seed, 7,709 implements and 247 tons of organic manures were sold.

In the **Punjab,** there is a cotton and wheat seed depôt in each circle, with sub-depôts at convenient centres. Seed sufficient to sow 68,426 acres of wheat and 275,530 acres of cotton were sold from these depôts during the year. There also exist

similar stores for the sale of improved implements, of which no fewer than 11,414 whole articles and 2,451 spare parts were disposed of. Poison baits of strychnine hydrochloride mixed with gram and *gur* have proved very effective for rat destruction. During the year 96 campaigns covering an area of 111,317 acres in five different districts, were carried out; it is estimated that over 9 million rats were destroyed. The average cost of the poison was 10·3 pies per acre.

In the **Central Provinces,** 14 departmental and 4,454 private seed farms were at work, from which 4,199 tons of seed were distributed; 7,672 iron ploughs, 1,158 other implements and 4,218 spare parts were sold. A demand has also grown up for pig-proof wire-fencing, of which 8 miles were sold in the Northern Circle. The district staff carried out 1,758 practical demonstrations and gave 41 illustrated lectures, while the number of agricultural shows held was 26. The propaganda work of the department is ably supported by non-official bodies such as agricultural associations, co-operative shops, seed associations and private demonstration farms. The 38 shops opened in Berar for the sale and hire of improved implements earned a profit of Rs. 11,460 on a capital of about Rs. 60,000.

To enable seed distribution to be carried on, selected cultivators and co-operative societies have been induced in **Burma** to open private seed farms which obtain yearly a supply of pure seed from Government central farms. The seed producing areas on the central farms are, however, not sufficient to supply all the demands made by private seed farms which now number nearly 250; steps are therefore being taken to increase the number of Government seed farms. In certain areas agricultural unions are being formed which consist of cultivators who take seed from the Government farms as a short-time loan, on the joint security of the members of the unions.

Seeds, manures and implements of the value of Rs. 83,486 were issued from the three depôts in **Assam.** A beginning has been made during the year in the direction of supplying seed, manures, etc., through co-operative societies; 11 new societies

have been started for this purpose. It is gratifying to know that a large number of men of the *bhadralog* class are coming forward to run private farms in accordance with the advice of the department.

In the **North-West Frontier Province** excellent work is being done by a very small staff in distributing cane, wheat and clover seed, and budded fruit trees of the best varieties; 25,000 trees were supplied from the Government farm at Tarnab.

Ryots in **Mysore** are freely coming forward to lay down demonstration plots on their own lands: in the Eastern Division alone there were 500 such plots in the year under report. For the distribution of seed, manures and implements co-operative societies and village panchayets are largely utilized, and special agricultural societies run on co-operative lines are coming into being. Nearly 475 pattas of *ragi*, 14 tons of paddy, seven lakh setts of sugarcane, 325 tons of manures, and 887 Mysore ploughs were supplied by the department.

In order to meet the large demand for coconut seedlings in **Travancore,** a new nursery has been started. Manures of the total value of Rs. 13,000 were sold from the 12 departmental and 24 agency depôts at work.

The seed organization in the **Baroda** State is mainly devoted to the spread of 1027 A.L.F. cotton and Pusa wheats; over 160 tons of cotton seed were sold during the year.

The distribution of pure seed of the long-stapled Gaorani cotton formed the principal item of district work in the **Hyderabad** State.

Some improved seed and over 17,000 fruit trees were issued from the State nurseries in **Kashmir.**

CHAPTER VI.

AGRICULTURAL EDUCATION.

Three grades of agricultural institutions, each with a distinct aim, are maintained by the Agricultural Department in India. First come the agricultural middle schools started in recent years in some provinces as an experimental measure. These special schools are intended to provide a course of agricultural training suitable for the sons of tenants or small zemindars who intend to take up farming on leaving school. The course provides for the training of the students in the practice of agriculture. To the provincial agricultural colleges is assigned a dual rôle. They train men for employment in the department, and they provide, too, a course of training for students who are desirous of turning their instruction to practical account in private farming or estate management. There are now six such colleges at Poona, Coimbatore, Lyallpur, Nagpur, Cawnpore and Mandalay, of which the first four are affiliated to the local universities. The three eastern provinces of Bengal, Bihar and Orissa, and Assam are at present without an institution imparting higher education in agriculture. The Agricultural Research Institute at Pusa and the Imperial Institute of Animal Husbandry and Dairying at Bangalore provide facilities for post-graduate courses qualifying for the highest appointments in the Agricultural Services.

Some of these institutions also give short courses of a practical nature in special subjects.

I. Higher Agricultural Education.

THE AGRICULTURAL COLLEGE AT POONA had this year on its rolls 184 students, including 85 freshmen. This number is higher than that of the previous year by 21. The results of the university examinations were on the whole satisfactory; out of 64 candidates for the degree of B.Ag., 59 passed. The university has adopted a new syllabus for its examinations which is considered an improvement on the old one. Its main

features are the increased importance assigned to agricultural engineering, the stress laid on agricultural economics, and the reduced amount of specialization provided for.

There was a further reduction from 68 to 49 in the number of applicants for admission to the three-year B. Sc. Ag. degree course of the AGRICULTURAL COLLEGE AT COIMBATORE. It was however, possible to form a full first-year class of the required strength of 20. At the degree examination held during the year, six out of eight students passed in Part I, while 11 out of 12 passed in Part II. The two-year certificate course has been abandoned; the proposal to replace it by a special Intermediate course with agriculture as the main subject is still under consideration.

The AGRICULTURAL COLLEGE AT LYALLPUR continues to provide two distinct courses, *viz.*, (1) the four-year degree course which is subject to university rules and regulations, and (2) the two-year leaving certificate course. Although the number of applications for admission dropped from 180 to 140, there was a higher proportion of candidates of superior calibre; the number admitted was 64 as against 53 in the previous year. In all, 31 students and ex-students qualified for the degree of B. Sc. and the college certificate. The scheme for leasing out 50 farms of 75 acres each to agricultural graduates for a term of five years is maturing. Such practical experience will, it is thought, not only help to qualify them in estate management, but will encourage them at the same time to undertake farming on their own account.

The number of applications for admission to the two courses —the diploma course of four years and the vernacular course of two years—provided at the AGRICULTURAL COLLEGE AT CAWNPORE slightly exceeded that in the previous year. Out of 49 students selected, 22 for the senior course and 27 for the junior course, only 26 per cent. joined with the declared object of obtaining Government service. In the annual examinations, 16 out of 18 students obtained the diploma, while the certificate was awarded to 18 of the 19 examined. The college has been provisionally recognized by the Board of High School and Intermediate Education in the United Provinces for an Intermediate

diploma in agriculture, and in future students will be required to obtain it before proceeding to the third year's course.

The necessary changes affecting chiefly the staff and curriculum having been effected at the AGRICULTURAL COLLEGE AT NAGPUR, the local university has established a faculty of agriculture and affiliated the college with effect from July 1925. During the year under report, the college worked on pre-established lines; there were 22 students in the two-year certificate course and 66 in the diploma course. In the final examinations, five students obtained the diploma, and the same number the certificate.

Of the 24 students of the High School Final standard admitted into the AGRICULTURAL COLLEGE AT MANDALAY which started working in July 1924, 11 proved incapable of benefiting by the course. An attempt to raise the standard of admission having failed, it has been found necessary to abandon the idea of affiliating the college to the Rangoon University. The High School Final will continue to be the entrance standard, and a three-year diploma course will be substituted for the degree course previously proposed. In the 1925 session, 19 candidates possessing High School Final qualifications have been admitted.

The second session of the post-graduate courses in Agricultural Chemistry, Botany, Mycology, Agricultural Bacteriology and Entomology, each extending over two years and qualifying for superior appointments in the Agricultural Services, commenced at the AGRICULTURAL RESEARCH INSTITUTE AT PUSA on 1st November, 1924. There were 32 candidates for admission. Of the six possessing the necessary qualifications chosen by the Selection Committee, one did not join and two left early in the year. The remaining three (one each for Agricultural Chemistry, Botany and Mycology) are undergoing training together with two (one each for Botany and Entomology) admitted in the previous year. The five post-graduate students of the Imperial Institute of Animal Husbandry and Dairying were given short courses at Pusa in estate management, cattle-breeding, plant-breeding, plant diseases, etc., during the last two months of their period of training. In addition to these, two

students took a special course in Entomology and one a special course in Agricultural Bacteriology. Eight students took short courses in Entomology and two in Lac-culture, and a batch of students from the Allahabad University visited the Entomological Section during Christmas week.

The fifteen-month post-graduate course in animal husbandry and dairying started on 2nd January, 1924, at the IMPERIAL INSTITUTE OF ANIMAL HUSBANDRY AND DAIRYING at Bangalore, was completed by five students during the year under report. There were 21 applications for admission during the second session and of these two were selected. For want of hostel accommodation there were no fresh admissions to the Dairy Diploma course. Short courses given at Bangalore and Karnal in cattle-breeding and dairying were taken by 12 students.

II. Agricultural Schools.

There were 169 students on the rolls of the six agricultural schools in the BOMBAY PRESIDENCY which provide a vernacular course of two years in practical agriculture. Some of these schools are also used as training centres for teachers who are employed later in certain primary schools in which an effort is being made to give education an agricultural bias. The latter schools are becoming popular, and their number will be extended as fast as teachers trained to the work can be turned out.

There are two agricultural middle schools at Taliparamba and Anakapalli in MADRAS, from which 13 and 6 students respectively passed out during the year. Of the 38 pupils hitherto fully trained at these schools, only 10 are known to have returned to [illegible] land.

[illegible] of students at the one agricultural school in [illegible]GAL, namely, that at Dacca shows that there is no demand for this type of education in that province. In spite of considerable advertisement there were this year only five qualified candidates against 15 vacancies. The agricultural classes attached to the Amarpur and Durgapur secondary schools, the Methodist Episcopal Mission at Asansole and the Church Mission school at Chapra (Nadia) are, however, reported to be doing

well. Definite proposals for introducing agriculture in the curriculum of secondary vernacular schools, as has been done in the Punjab, are now before the Government.

The agricultural school at Pathra (Godda) in BIHAR AND ORISSA, the missionary management of which receives a monthly subsidy, had 40 students under training during the year under report.

Forty-five students were in residence at the Bulandshahr school in the UNITED PROVINCES. Of these, thirty-five took the two-year course and ten were teachers of middle vernacular schools. It is proposed to provide at this school a short course of six months for the training of fieldmen.

The Chandkhuri school in the CENTRAL PROVINCES failed to attract students and has been closed; the Powarkhera school, on the other hand, appears to be gaining in popularity. It had 22 students under training as against 18 in the previous year.

There are no special agricultural schools in the PUNJAB, but ordinary vernacular middle schools in rural areas are being utilized for imparting a practical training in agriculture. The special features of the scheme are that (*a*) a small farm or plot is attached to the school, and (*b*) that elementary training in agriculture is given by a teacher specially selected for the work and trained for a year at the Agricultural College at Lyallpur. The number of such schools at the close of June 1925 was 67. The success of the Punjab experiment, which owes not a little to the initiative of Sir Michael O'Dwyer, has attracted wide notice, and steps are being taken in at least three more provinces to adapt it to their respective conditions.

The subsidized agricultural school at Pyinmana in BURMA, which is managed by the American Baptist Mission, has 62 students.

The Hebbal and Chikkanhalli schools in MYSORE continue to attract students. Four out of the eight students in the final class at Hebbal obtained the diploma, while all the 15 students at the other school qualified for a certificate.

There were 15 students at the Alwaye school in TRAVANCORE.

III. Short Courses.

The six months' practical vernacular course at LYALLPUR was taken advantage of by 22 students, while 26 senior vernacular teachers qualified themselves for the teaching of agriculture in rural middle schools. The rural economy class, which lasts for a month, was attended by 15 officers of other departments. With a view to training village blacksmiths to repair oil-engines and modern implements, which are rapidly coming into use in the province, a month's course is given at the agricultural workshop.

The classes for juvenile and adult labourers at the agricultural stations at Coimbatore, Palur and Anakapalli in MADRAS continued to work satisfactorily.

In BURMA, short courses were given to 121 adult farmers at Hmawbi, Mahlaing and Tatkon.

A course of lectures on various aspects of agriculture was arranged for young officers of the Indian and Provincial Civil Services in the CENTRAL PROVINCES. The object in view is to give them an insight into the work of the department and to show them the bearings of improved agriculture upon the welfare of the rural community.

In addition to eight Kamdars for central co-operative banks, one private student and an inspecting clerk of the Co-operative Department were under training on the central farms in BIHAR AND ORISSA.

In ASSAM, eight apprentices were under training at different farms of the province for employment as demonstrators.

The steady building up of a system of research and education is the accepted policy of the department as a whole. The Central Government has made provision at Pusa and Bangalore for training in research. Most of the provinces and some of the Indian States have their own agricultural schools and colleges, and on some of their farms short courses of training in general agriculture and in the technique of improved methods are being given. Much has already been done, and the way has been paved for a great advance when more men and money will be made available for this line of work. Up to the present Government has had

to provide the driving power and almost all the money spent on agricultural education in this country. Mission bodies have in some provinces done useful work in this direction. I should like to mention in particular the work done by Mr. Higginbottom and his staff at the Allahabad Agricultural Institute, where lakhs have been spent on agricultural education. The time will come we hope when the landed aristocracy of this country will follow the fine example of their class in England and other countries in the West, by whose generosity it has been possible to establish and endow many educational and research institutions for the development of agriculture in these lands.

CHAPTER VII.

THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE.

The most obvious economic evil from which agriculturists in India suffer is the lack of capital; the agricultural problem to which co-operation came to be first applied was therefore that of indebtedness. With the numerical increase in credit societies a knowledge of the principles underlying co-operative work has gradually spread among the people, and in areas where these have been best understood, they are being applied to other branches of business besides the borrowing and lending of money. In most European countries, too, forms of co-operative activity connected with purchase, production and distribution were not undertaken until credit societies had been firmly established, and development in India has followed the continental precedent. In a relatively backward population the difficulties involved in the management of productive and distributive business are felt to a greater extent, but the results hitherto achieved are by no means discouraging. The success of cotton sale societies in Bombay, of irrigation and milk societies in Bengal, and of societies for the consolidation of holdings and clearance of silt in the Punjab has opened up a vista of great possibilities for the future for the co-operative movement. The following facts and figures give some idea of the progress of the co-operative movement in the different provinces.

Bombay. The number of agricultural societies of different types rose to 3,377—an increase of 327. The membership increased from 220,616 to 242,674 and the working capital from Rs. 1,97,61,913 to Rs. 2,49,98,442. The number of non-credit societies increased from 190 to 223. Good progress was made in the development of sale societies, of which the most important are those dealing in cotton. Over 7½ lakhs lb. of manure were sold by 17 societies organized for the purpose. In addition, a large quantity passed through the shops of the Provincial Co-operative Bank. Of the seed societies, the one at Malir indented for potato seed to the extent of about Rs. 45,000,

and distributed it among its members. There are nine fencing societies, out of which six have completely constructed their walls and thus afforded protection to the lands of their members from the ravages of pigs and other animals. The nine cattle-breeding societies at work in the Southern Division are giving promise of success.

Madras. The number of agricultural credit societies rose from 8,103 to 9,164, the membership from 438,465 to 487,431, and the working capital from Rs. 3,14,97,536 to Rs. 3,58,07,324. A new development of note was the registration of two land mortgage banks. Of the 78 non-credit societies engaged in the sale or purchase and sale of agricultural requisites and products, only 39 worked at a profit. There are also in the presidency one irrigation society, two land reclamation societies, one for the purchase of manure and agricultural implements, and one for the demonstration of improved methods of cultivation. The Malabar District Co-operative Manure and Agricultural Implements Society purchased sprayers and chemicals to the value of Rs. 16,891 and distributed them among members to enable them to deal with *mahali* disease amongst their areca-nut trees.

Bengal. The number of agricultural credit societies rose from 8,368 to 9,835, the membership from 216,190 to 246,043, and the working capital from Rs. 1,77,89,251 to Rs. 2,13,81,661. The societies for agricultural purchase and purchase and sale increased from 22 to 33 and their profits from Rs. 3,620 to Rs. 17,761. The most flourishing supply societies are the Sunderbans, Gosava, Naogaon and Kazipur; the first three did a big business in rice and the last in jute. Irrigation societies have proved their usefulness in the presidency, and their number has risen from 173 to 268. Of the latter, 142 are in Bankura and 116 in Birbhum controlling in the aggregate a total area of over 20,000 acres. The co-operative agricultural associations started to run model farms on commercial principles now number 20, but their working does not give promise of success. The Naogaon *ganja* cultivators' society continues to flourish.

Bihar and Orissa. The number of agricultural societies rose from 5,108 to 5,862, the membership from 145,102 to 159,798, and the working capital from Rs. 1,15,85,696 to Rs. 1,38,82,866. The non-credit societies specially devoted to purchase and sale, and production and sale, are almost all in a bad state; but 40 central banks took an active part in the development of agriculture by supplying improved seed, manures, etc. One hundred and thirteen grain *golas* (stores), with a membership of over 22,000 and a working capital of Rs. 2,35,000, made a profit of Rs. 32,824. The *golas* afford relief to the members in the shape of loans at very low rates of interest and serve as a reserve stock for use during years of scarcity.

United Provinces. The number of agricultural societies rose from 5,444 to 5,677, the membership from 130,949 to 140,476, and the working capital from Rs. 74,92,490 to Rs. 82,84,852. There are now five non-credit societies only in existence in this province, and they too may have to be closed. The two central agricultural supply societies are, however, flourishing; they made a profit of Rs. 2,651 on a working capital of Rs. 34,149.

Punjab. The number of agricultural societies of different types increased from 9,791 to 11,409, the membership from 253,831 to 305,173, and the working capital from Rs. 2,93,82,591 to Rs. 3,60,99,637. The three mortgage banks at work during the year redeemed 2,697 acres of land and 389 palm trees; the fourth which is in Rawalpindi is about to make a start. Societies for consolidating holdings now number 174 with 8,412 members; about 10,411 acres were readjusted, the number of blocks reduced from 17,707 to 3,255, and the average size of blocks increased from 0·6 to 3·75 acres. Of the 22 societies for silt clearance, ten raised their irrigated area from 663 to 3,125 acres and gained for their members an estimated profit of Rs. 50,000 in the year. At the close of the year, there were 43 societies for cattle-breeding and 5 for sheep-breeding. These societies had 1,000 members who maintained 1,133 cows and 503 ewes. Another useful type of society in this province is that which advocates better farming. Of this type there are

now 18 with 574 members. Like those for stock-breeding, they aim primarily at propaganda. Twelve co-operative commission sale shops were at work during the year. Of these, the one at Okara sold for members produce worth Rs. 16 lakhs.

Central Provinces. There was a further decrease in the number of societies of all kinds. The number of agricultural credit societies declined from 4,263 to 4,142 and the membership from 66,710 to 61,736; but the working capital rose from Rs. 1,21,13,318 to Rs. 1,35,39,518. The number of agricultural seed unions has dwindled to 16, of which many are in a moribund condition. The production and distribution of Roseum cotton seed continued to be their activity, over 2,222 tons having been supplied by them during the year. There was one addition in the number of agricultural associations for the sale and hire of implements; these earned a profit of Rs. 5,462 on a paid-up capital of Rs. 27,251. The working of the Akola commission shop was affected by an unfavourable season, and the sales dropped to Rs. 72,634.

Burma. The number of agricultural credit societies declined from 4,211 to 4,172 and their membership from 98,167 to 95,405; but the working capital of Rs. 2,04,61,528 exceeded that of the previous year by over two lakhs of rupees. The non-credit agricultural societies, of which there are 99, are in an unsatisfactory condition; some are doing no business, others are working at a loss. To quote the Registrar, " the development in this branch of co-operation will have to await the day when societies are strong enough to entertain expensive managers, and to see that they get their money's worth out of these men."

Assam. The number of agricultural societies rose from 642 to 761, the membership from 28,420 to 32,566, and the working capital from Rs. 9,77,578 to Rs. 12,03,875. There are no non-credit agricultural societies in this province.

Co-operative Cotton Sale Societies.

During the year under report, the value of cotton sold by co-operative cotton sale societies in the Bombay Presidency

amounted to Rs. 46 lakhs. Though this figure is less than that of the previous year by Rs. 7½ lakhs, the business done was appreciably larger. For instance, the Hubli and Gadag societies, which are the oldest and the biggest, each dealt with 82,000 maunds of cotton, as against 79,000 and 72,000, respectively, in the previous year. These societies were also instrumental in distributing a large quantity of improved cotton seed. In Gujarat, where the number of cotton sale societies has risen from 9 to 17, the total turn-over of Rs. 12¾ lakhs was double of that of the season 1923-24. With a view to concerting measures for formulating a common policy of work and development, the societies in Gujarat propose to form themselves into a federation. They are distinguished from societies in other parts of the presidency in that they sell only members' cotton, and no one is admitted as a member who does not use the improved seed distributed by the societies.

Co-operative Milk Societies.

In the BOMBAY PRESIDENCY, the number of dairy societies has remained at four. They sold milk of the value of Rs. 45,000 and earned a profit of Rs. 3,000. There are now 63 milk societies in BENGAL; all of them are affiliated to the Co-operative Milk Union in Calcutta. The latter disposed of 2-3 tons of milk daily and realized Rs. 2,47,988. Starting with a loss of Rs. 5,315 during the first year of its working in 1920, the Union made a profit of Rs. 20,146 last year. In the CENTRAL PROVINCES, the Amraoti dairy again worked at a loss, but the *gaoli* society at Telinkheri near Nagpur earned a net profit of Rs. 7,138 on sales of Rs. 29,425. The success of the latter and of the Calcutta Milk Union has demonstrated that the co-operative organization of actual producers is the best possible agency through which a reasonably cheap supply of pure milk can be obtained. The dairy society at Allahabad in the UNITED PROVINCES and that at Bhagalpur in BIHAR are just paying their way.

Cattle Insurance.

This form of co-operation should be recorded as a decided failure. Even in BURMA, where there are 397 societies on

paper, the amount of risk insured fell from Rs. 83,604 to Rs. 56,304 and the premia collected from Rs. 2,899 to Rs. 1,604. In the PUNJAB all cattle insurance societies, except one which was overlooked, have been cancelled, as well as the Reinsurance Union. Of the nine societies in BOMBAY, only one was able to collect premia, and the only society in the UNITED PROVINCES did no business.

CHAPTER VIII.

LIVE STOCK.

I. Prevention and Treatment of Disease.

With the recrudescence of rinderpest in an intense form, after a comparative respite of over three years, the reported mortality from contagious diseases rose from 200,962 in 1923-24 to 266,477 during the year under review (Appendix VII). Of the latter figure, as many as 170,029 deaths were due to rinderpest which even when at low virulence levies as heavy a toll on cattle in this country as all other contagious diseases put together. The principal sufferers were the Bombay Presidency, the Punjab and the Central Provinces which lost through rinderpest 36,564, 31,750 and 22,475 cattle as against 5,166, 12,460 and 2,631 respectively in the previous year. The other provinces recording more than 10,000 deaths from this disease were Bengal, Bihar and Orissa, Assam and Burma.

Such a heavy increase in the incidence of disease resulted in the services of the veterinary staff being requisitioned to a larger extent than in the previous year. While in 1923-24, the cases treated at the veterinary hospitals and dispensaries and by itinerant veterinary officers numbered 2,373,909, during the year under report 2,740,121 animals were offered for treatment. The number of inoculations carried out rose from 812,141 to 968,431. When it is remembered that in 1919-20 while the mortality from contagious diseases was 337,396, the numbers offered for treatment and inoculation were respectively 2,032,439 and 709,795, the extent of the increasing confidence on the part of the Indian peasant in the work of the Civil Veterinary Department will be readily realized. It is, however, a pity that many local bodies, upon whose financial assistance the department is dependent for district work, are still unwilling or unable to provide funds for employing the staff necessary to meet the ever-increasing calls made on the department for veterinary aid. For example, in the Bombay Presidency during an epidemic of rinderpest of almost unprecedented virul-

ence, inoculations could be undertaken only in about 50 per cent. of the outbreaks attended.

In addition to the saving of cattle life from the ravages of disease, the Veterinary Department performs the important function of emasculating inferior and undesirable bulls. During the year under review, 195,427 scrub bulls were castrated throughout India, of which as many as 109,432 were dealt with in the Punjab. Other provinces where more than 10,000 animals were offered for this operation were the North-West Frontier Province, the Central Provinces, Madras and Bombay. It is noteworthy that great aversion to getting scrub bulls emasculated exists in provinces where the worst types of cattle are to be found. As the introduction of the Burdizzo castrator, by which an animal can be rendered sterile without cutting the skin or shedding blood, has rendered the operation unobjectionable to the religious susceptibilities of the people, an appreciable increase in the number of animals offered for castration may be expected in the near future.

II. Incidence of Disease.

Bombay. With the solitary exception of one district, the whole presidency suffered from severe outbreaks of rinderpest and 36,564 cattle succumbed to this disease alone, as compared with the total mortality of 11,457 from all contagious diseases in the previous year. Other diseases prevailed in a mild form and accounted for only 4,309 deaths.

Madras. The mortality from rinderpest was three times as high as in the previous year, and this contributed to the increase in the total number of deaths reported from 23,134 to 29,654. Blackquarter, however, was less prevalent and the mortality of 2,068 was less than half of that of 1923-24.

Bengal. There was a further drop in the mortality from contagious diseases, the figures for the last three years being 31,780, 27,389 and 21,901 respectively. The most striking reduction was under the head rinderpest which ordinarily contributes 90 per cent. of the total number of deaths reported.

Bihar and Orissa. A severe outbreak of surra appeared at Jamshedpur and carried away 22 valuable animals. The mortality from contagious diseases of all kinds was slightly less than in the previous year.

United Provinces. Rinderpest appeared in a more virulent form than last year, and the total mortality rose from 8,760 to 18,050, of which 7,871 deaths were due to rinderpest alone. Surra also was more prevalent.

Punjab. Rinderpest was largely responsible for the increase in the total number of deaths reported, namely, 49,493, as against 39,394 for the previous year. As many as 31,750 cattle succumbed to this fell disease, as compared with 12,460 in the preceding year. There were fewer cases of surra reported and not a single case of dourine.

Burma. With a decrease in the incidence of rinderpest, the total mortality from all causes was 18,555 as against 20,141 in 1923-24. Deaths reported from surra numbered 184.

Central Provinces. The total mortality reported was 28,763 which was almost double that of the previous year and four times that of 1922-23. This was due to the fact that rinderpest was widespread and accounted for 22,475 deaths, as against only 2,675 in the previous year.

Assam. The total number of deaths from contagious diseases was practically the same as in the preceding year, namely, 27,523.

North-West Frontier Province. There has been a steady rise in the mortality from contagious diseases during the last three years, the figures being 476, 1,183 and 1,978 respectively. Most of the deaths were due to rinderpest and hæmorrhagic septicæmia.

Sind. There was a further decrease in the number of deaths due to rinderpest; but the total number of deaths from all causes rose from 4,881 to 5,519. Of these, 2,794 deaths were caused by pleuro-pneumonia.

Baluchistan. The total number of deaths reported was 2,483 as against 3,450 in the previous year; anthrax alone was responsible for 1,320 deaths.

Rajputana. The number of deaths from contagious diseases rose from 34 to 1,060 owing mainly to the wider prevalence of rinderpest.

III. Preventive Inoculation.

The Imperial Institute of Veterinary Research at Muktesar, to call it by its new name, issued 3,535,699 doses of different sera and vaccines, as against 2,513,207 doses in the previous year. The increase was mainly due to the intense wave of rinderpest which spread over different parts of India in October 1924. The following table compares the doses issued during the year under review with the average for the previous five years :—

	1924-25	Average of previous five years
Rinderpest serum	2,848,110	2,558,884
Anthrax serum	48,405	28,836
Hæmorrhagic septicæmia serum . .	279,061	170,350
Do. vaccine	212,600	160,490
Blackquarter vaccine	28,800	36,410
Mallein	25,765	68,487

The ability of the Institute to supply in a short period an excess of nearly nine lakhs doses of anti-rinderpest serum over the figure of the previous year has fully justified the policy of manufacturing excess stocks during periods of depression in demand. The transfer of the greater part of the routine manufacturing work to the tributary plains sub-station at Izatnagar during the period under review has worked well. It is anticipated that there will always be three-yearly periods of depression alternated with similar periods of recrudescence of rinderpest in India, so long as measures of effective sanitary

police control are not practicable, and that the Institute will always have to be ready to cope with abnormal demands for serum.

The serum-alone method of inoculation against rinderpest has been accepted as the most suitable for India on account of its simplicity and absolute safety. The only claim made for it is that it carries an animal through an outbreak; that that claim is justified will appear from the fact that while the normal mortality from this scourge is about 75 per cent., the actual deaths amongst 707,345 bovines inoculated with serum alone amounted last year to only 0·34 per cent. Outbreaks of cattle plague cannot, however, be expected to be either less frequent or less virulent until all animals exposed to infection in an outbreak are compulsorily inoculated by the serum-alone method, or till permanent immunity is conferred by the adoption on a large scale of the serum-simultaneous method. With respect to the adoption of these methods, most notable steps have recently been taken in the Madras Presidency and the Mysore State. Under the powers conferred by the Madras Cattle Diseases Act, the former has legalized compulsory inoculation by the serum-alone method in villages notified by a District Magistrate; while the latter has decided to abandon the serum-alone treatment entirely and to adopt the simultaneous method on a large scale. The Mysore experiment now in progress is unique in the annals of cattle disease prevention in India and should be of the greatest value to the country.

The second most important cattle disease in India is hæmorrhagic septicæmia. In affected districts, notably in the Punjab, liable to seasonal visitations cattle are treated preventively on a large scale by vaccination. During the year under review, 164,473 animals were thus protected, of which only 9 succumbed.

The two other contagious diseases against which prophylactic measures are taken on some scale are anthrax and black-quarter. Results of inoculations made during the year show that the mortality among treated animals is as low as 0·05 and 0·201 per cent. respectively. The new germ-free filtrate pro-

duced at Muktesar to replace the vaccine hitherto in use against blackquarter had a successful trial in the field during the year under report. The relative merits of the two products were tested with the precision of a laboratory experiment on the Hissar farm, and the results were unquestionably in favour of the filtrate.

IV. Veterinary Education.

For the training of students in veterinary science, there are colleges at Bombay, Madras, Calcutta and Lahore, and schools at Insein and Taunggyi in Burma. Among the important developments of the year are the proposed conversion of the Insein school into a college and the project for the establishment of a college at Patna for Bihar and Orissa. The colleges at Bombay, Madras and Calcutta give a 3-year diploma course in English, while that at Lahore provides a 4-year course. With the passing out of the last batch of students, the old 3-year vernacular course at Lahore has been completely abandoned. The institutions at Madras and Lahore also conduct post-diploma classes for selected subordinate officers of the department. The number of students who passed the diploma examinations of the colleges increased from 82 in 1923-24 to 94 in the year under report. As a result of the increased rates of pay sanctioned for Veterinary Assistants, there has been more competition for admission to these institutions.

The veterinary schools at Insein and Taunggyi in Burma continued to impart instruction in the vernacular in a 3-year and a $1\frac{1}{2}$-year course respectively. Fifteen students passed the final examination at Insein as against 14 in the preceding year; while only one student passed out of the Taunggyi school. As the Insein school is being converted into a college and as the standard of admission to the same has not been fixed, no fresh batch of pupils was admitted this year. The foundation-stone of the new college building was laid by His Excellency Sir Harcourt Butler on 13th February, 1925.

Systematic courses of training in laboratory methods ranging in duration from two to six months have been instituted at

the Muktesar Institute for members of the Indian Veterinary Service, the Royal Veterinary Corps, and selected subordinate officers of the Provincial Civil Veterinary Departments; sixteen officers availed themselves during the year of the training facilities thus provided. Experience has shown that the training for short periods, particularly in the practical methods of modern disease investigation, of selected subordinates from the provinces is likely to conduce very effectively towards the rapid dissemination of important information concerning the control of animal disease throughout India.

Eighteen farriers were trained at Lahore, while at Calcutta 96 students under training as sanitary inspectors were given a course of lectures in infectious diseases of animals, and 15 riflemen of the Assam Rifles were trained as veterinary dressers. Six students passed out during the year from the veterinary compounders' class attached to the Nagpur dispensary.

V. Veterinary Research.

At the Imperial Institute of Veterinary Research, Muktesar, all the more important diseases of bovines and equines are being investigated by intensive methods of research, and some of the results obtained are mentioned below.

Rinderpest. Intensive research was again prosecuted upon this most serious disease. The factors which govern the survival of the virus in blood withdrawn from infected animals were investigated. In the light of the results obtained, it has been found possible to devise means of transporting the virus for long distances for use in the active immunization of cattle by the so-called serum-simultaneous method. In the production of a potent anti-serum for use in combating the disease it was discovered that " hyper-immunization " of the serum-producers which had hitherto been regarded as indispensable, was unnecessary, and that immune animals (buffaloes) could furnish a satisfactory serum for a period extending over three months, by merely adjusting the dosage of serum administered to them in the initial treatment, with virus and serum simultaneously, so that they exhibited a decided febrile reaction.

The possible transmission of rinderpest through the agency of *Musca domestica* and *Linognathus vituli* was further investigated. Infected insects were crushed in normal saline and the emulsion injected into healthy animals caused rinderpest, but all attempts to get the disease transmitted by natural methods failed.

Haemorrhagic septicaemia. The research work done on this second most important disease of cattle in India, has now culminated in the development of a very cheap and rapid method of anti-serum production, by the simultaneous inoculation of the producers (buffaloes) with a large initial dose of culture of living antigen of low virulence and a suitable counteracting dose of serum. Rigorous tests have proved that the use of antigen of low virulence leads to the production of an anti-serum of as high potency as that obtained after the use of highly virulent antigen. A most powerful immunity is set up in susceptible animals by the simultaneous treatment with anti-serum and a small dose of living culture of degraded virulence.

Contagious bovine abortion. The application of the agglutination test to the milch cattle belonging to some of the Government military dairies showed that about 50 per cent. are infected with the common form of this disease, and as a rule about 20 per cent. abort repeatedly. Tests upon cattle belonging to the " grantee " farms of the Punjab, however, showed that when stock are reared under " natural " conditions about 10 per cent. only are infected, while none would seem to become clinically affected with abortion. Efforts to vaccinate cattle at the military dairies by the inoculation of massive doses of living culture, whether of low or high virulence, have hitherto been discouraging. Steps are being taken to investigate more thoroughly the factors governing the production of immunity against this harassing condition.

Bovine tuberculosis. The services of a trained worker (Dr. M. B. Soparkar) from the Indian Research Fund Association were secured in 1923 with a view to investigating this problem. The experimental evidence hitherto available would seem to indicate that Indian breeds of cattle do not possess a degree of

resistance which is notably superior to that possessed by cross-breds containing a large admixture of European blood, and that the strains of tubercle bacilli isolated from natural cases of the disease in India display as high a degree of virulence as those grown from the lesions of cattle in Europe. The relatively rare occurrence of the disease among cattle in India would appear to be due to the manner in which they are ordinarily bred and raised.

Surra. Buffaloes suffering from the effects of invasion with exalted strains of *Trypanosoma evansi* have been found readily amenable to treatment by intravenous injections of tartar emetic and certain bismuth salts; but even powerful trypanocidal agents such as tryparsamide were not capable of producing a complete sterilization of the system.

Contagious equine abortion. Attempts are being made to limit the spread of infection due to *Bacillus abortivo-equinus* in a number of important breeding studs in India by the segregation of carriers detected by the application of the agglutination test.

Blackquarter of cattle. Steps were taken to estimate the efficacy of "germ-free" products in preventive inoculation against this disease.

Strangles. Large scale researches upon the preventive treatment of this disease are being carried out at Army Remount Depôts.

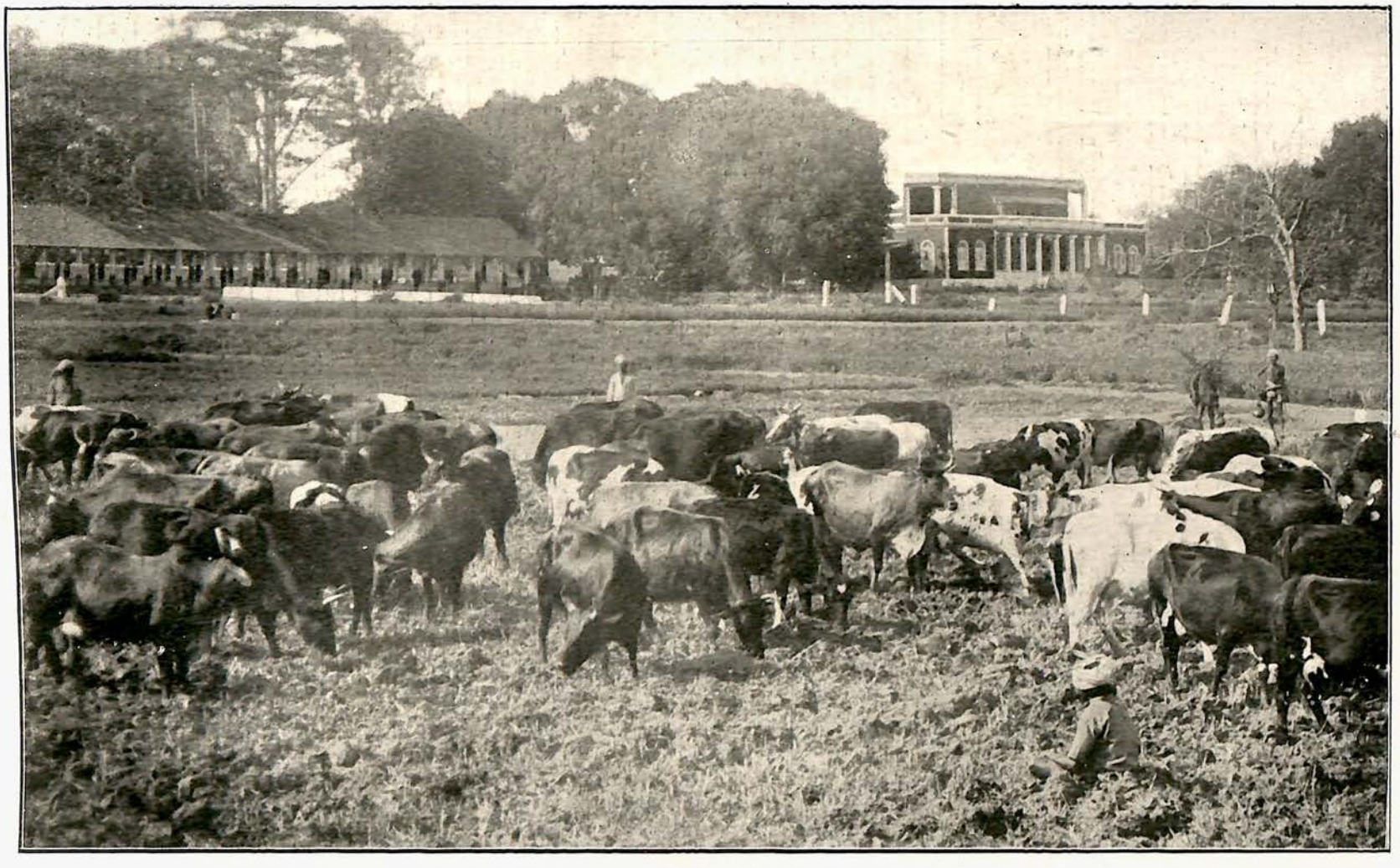
Among other investigations of importance may be mentioned those relating to piroplasmosis and coccidiosis and the identification of micro-organisms responsible for certain disease conditions in India.

VI. Breeding.

Cattle-breeding. In Indian agriculture cattle play a larger part than they do in most countries, and naturally the cattle-breeding industry has received considerable attention within recent years. The Imperial and Provincial Departments of Agriculture, as well as some of the more advanced Indian States, have drawn up cattle-breeding schemes based on the assumption

that there are too many scrub half-starved cattle in this country, and that what is wanted is an improvement in the quality of our live stock. Improvement can be effected, it is believed, by selective breeding, cross-breeding and better feeding. The different breeds are therefore being studied, and pure bred herds established with the view of providing a foundation whereon the edifice of improved cattle-breeding and dairying can, in course of time, be raised. Given this foundation, it is possible to raise breeds of cattle which will give good draught bullocks and profitable milch cows. Much attention is also being paid to the question both of growing and storing fodders; for there is no gainsaying the fact that there is not at present enough fodder of the right sort to maintain in good condition the cattle required for milk and draught. Several very promising fodders have been introduced and methods of storing them in the dry state or as ensilage adopted. Accurate information regarding the digestibility and nutritive values of different foodstuffs and fodders is also being collected at the Institute of Animal Husbandry and Dairying, Bangalore, where these problems are being investigated. Facilities for a thorough training in the theory and practice of animal husbandry and dairying have also been provided at this Institute.

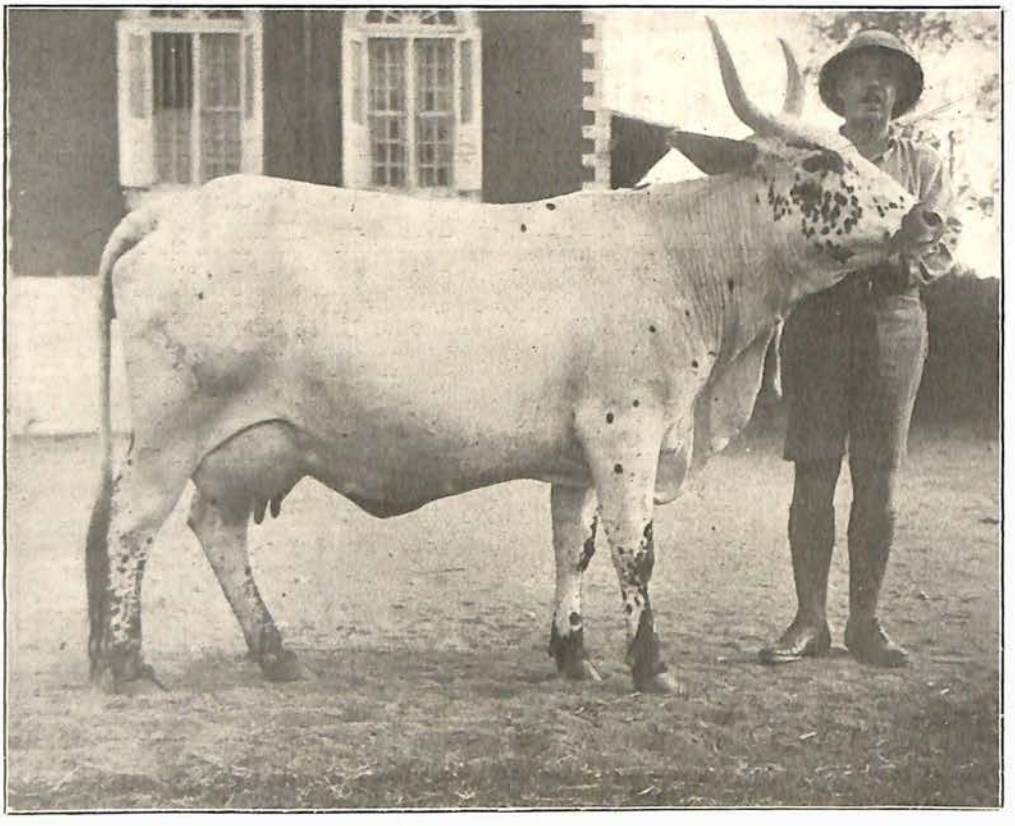
With a view to stimulating, and to some extent co-ordinating the efforts being made towards cattle improvement, the Government of India have decided to give effect to the recommendations made by the Board of Agriculture in 1924, and to establish a Central Cattle Bureau at Bangalore. The main duties of this Bureau, to commence with, would be: (1) to collect and disseminate information concerning cattle-breeding and allied subjects, (2) to assist in the disposal of surplus pedigree stock available on Government cattle-breeding farms, (3) to standardize breeding records and methods of milk recording, (4) to maintain general herd-books of breeds, or of milch cattle as distinct from specific breeds found in more than one province or State, (5) to encourage the use of pedigreed stock, and (6) to keep the officers in charge of cattle-breeding in provinces and States in touch with each other. It is hoped that sufficient



DAIRY AND CATTLE SHEDS AT BANGALORE WITH CROSS-BRED HERD IN FOREGROUND.

PLATE VII.

PLATE VIII.



Half-bred Ayrshire-Sahiwal Cow No. 960, Bangalore. Gave 9,732 lb. and 9,786 lb. of milk during last two lactations.

co-operation will be forthcoming from Government departments as well as private individuals to make this Bureau of real value.

In the control of cattle-breeding operations in India it is now being realized as never before that the selection of the sire is of paramount importance in cattle-breeding, more especially when the aim in view is to establish a breed suitable both for draught and dairy purposes. Milking character is difficult to detect in the female and impossible to detect in the male. The sire's value can be gauged only on the performance of his daughter; but until that information becomes available we have to rely on the sire's pedigree which is based on the performance of his ancestors. This information, which is so essential in establishing pedigree herds, is now being patiently built up both at Pusa and on certain other Government farms where accurate methods of recording are practised.

As explained in previous reviews, cattle-breeding operations at PUSA have been directed along two lines: (1) a herd of Sahiwals is being graded up by selective breeding, and (2) poor milkers of the same breed are being crossed with Ayrshire bulls of high milking pedigree with the primary object of obtaining reliable information regarding the inheritance of observable characters in the crosses.

The present milk yield of the Sahiwal herd (11·1 lb. per cow per day) is now almost double that of the herd 10 years ago; while the immediate result of the cross-breeding has been to produce animals giving on an average almost double the quantity of milk of the best Sahiwals. In the light of the fact that the dams of the cross-breds were the worst milkers in the herd, the result obtained is very gratifying. The maintenance of the high milk yielding qualities in the subsequent generations of a cross-bred herd is, however, a matter of considerable difficulty. The three-quarter Ayrshire is inferior to the first cross both in stamina and milk yield, as are also the cross-crosses produced by mating first crosses. While the success of the first cross has clearly demonstrated a sure and rapid method of creating high milk yielding cows for dairying purposes, the indications are that having produced a cross of good milking capacity by adding

Ayrshire blood our policy should be to adapt that strain to the needs of the country, by mating the cross-bred dams with Sahiwal bulls of good milch pedigree. That is now being done at Pusa, and the chances are that in course of time a well-defined Sahiwal-Ayrshire strain will be evolved which, though inferior to the first cross in milking capacity, will be hardier and more adaptable. Any system of breeding which loses sight of the importance of constitution, stamina and good conformation is doomed to failure.

The experiments in breeding carried out at Pusa have proved that the sire is prepotent as regards milk production, that a cow's dry period can be shortened by weaning the calf from birth, and that the milk yield of a herd is much increased when the cows are given green food throughout the year.

On the farms at KARNAL, BANGALORE AND WELLINGTON, under the control of the Imperial Dairy Expert, three of the best indigenous milch breeds are being improved by selective breeding and better feeding. Two of these indigenous breeds are being crossed with two of the best known milch breeds of the West, *viz.*, the Ayrshire and the Holstein.

The principal breeds of cattle in the PUNJAB are (1) the Hariana, (2) the Dhanni, and (3) the Sahiwal. The first two are essentially draught breeds, while the third is better known as a milch breed. The policy is to preserve and improve these breeds by a process of selection from among the best specimens available. By the very thorough application of this principle, the famous Hissar breed of Hariana cattle has been established. Over 1,700 bulls of this breed are now at stud throughout the province, of which about 300 were purchased by the district boards during the year under review. With a view to meeting the growing demand for bulls of this breed, three additional breeding farms have been started by private cattle-owners who have been given grants of Government land. Owners of approved bulls in the Hariana tract which comprises the districts of Rohtak and Gurgaon are also subsidized on condition that the services of their bulls are available for the villagers' cattle. Four hundred and six such bulls were at stud during the year,

THAR-PARKAR HERD AT KARNAL FARM.

PLATE IX.

PLATE X.

HARIANA COWS AT KARNAL FARM.

of which 110 were obtained by the Gurgaon District Board from the Hissar farm. Under a similar scheme in operation in the Dhanni tract comprising the districts of Rawalpindi, Attock, Jhelum and Mianwali, 12,290 cows were covered by 108 bulls, as against 7,157 by 91 bulls in the previous year.

Land for three cattle-breeding and two dairy farms has been given on lease by Government with the object of preserving and improving the Sahiwal breed. These five grantees occupy 11,848 acres of land, and their farms carry 1,525 approved cows and 23 approved bulls. Small parcels of land totalling 5,000 acres have been granted to the Jungalis and Sayads of the original home of the Sahiwal breed on condition that they maintain two approved cows per square of 25 acres. Milk records are being maintained at all the farms of the lessees, and an attempt is being made to start co-operative milk testing societies for the smaller grantees. With a view to further stimulating cattle improvement in the Sahiwal tract, the Government propose to open in the new Montgomery colony a number of 3,000-acre farms to be run on the lines of the Hissar farm.

It may also be mentioned that since the close of the year under review, the Punjab Government have reduced the water rate for fodder crops to Rs. 2 per acre to encourage cattle rearing in the canal colonies. It is to be hoped that the results of this policy will be commensurate with the annual sacrifice of nearly 20 lakhs of rupees in revenue.

In the North-West Frontier Province, 38 bulls belonging to local bodies were at stud during the year. The small herd of Awankari cattle started at the Tarnab farm in 1916 has produced excellent specimens of the breed.

In the United Provinces, the Department of Agriculture maintains two cattle-breeding farms, one at Madhurikund in the Muttra District and one at Manjhra in Kheri Lakhimpur. A herd of the Hissar or Hariana cattle is kept on the former, and herds of Sahiwal and Kherigarh breeds and Murra buffaloes on the latter. The experiment of acclimatizing the Sahiwal and Murra breeds to Terai conditions has proved a success. With a view to investigating the possibilities of improving the milking

capacity of the Hissar and Kherigarh breeds, which are noted for their draught qualities, cows of the former are being crossed with Holstein bulls and cows of the latter with Sahiwal bulls. It is proposed to establish a model dairy at the Madhurikund farm with a view to ascertaining the milking capacity of the Hissar breed. There is a keen demand for bulls reared on Government farms, but only 79 requisitions could be met; the total number of selected bulls now at stud in the province is 328. In order to increase the supply of bulls two controlled breeding areas have been started in the districts of Muttra and Etawah, in which approved bulls are located in every village. It is intended to treat these areas, so far as the co-operation of the villagers will allow, as large breeding farms, so that they may eventually become centres for the supply of improved bulls to other districts. The two village dairy schemes initiated with the help of Government subsidies in the Agra and Aligarh Districts have shown that it is possible to transport milk by road for distances of 10 miles, and to deliver it in good condition in city markets at a remunerative price.

The present policy of the BIHAR AND ORISSA Government in respect of cattle-breeding and dairying is to start dairy herds at Government farms whenever the demand for milk makes it possible to do so without considerable loss. There are such dairies at Sabour, Monghyr and Kanke. A small herd of local cows is maintained at Cuttack for purposes of experimental crossing with Sahiwal bulls, in order to produce a dual-purpose breed suitable for Orissa. The report of the Committee appointed during the year to advise as to what further steps should be taken to improve the cattle of the province, is now before the local Government, and it is to be hoped that it will be possible to give effect to their comprehensive recommendations.

The mating of BENGAL cows at the Rangpur farm with Hissar bulls has produced a desirable cross suitable for the province. The milk yield has been much improved, and the bulls produced on the farm are of good stature. The Scindi herd being acclimatized at Dacca shows great promise; to that station the Thar-Parkar cattle from Rangpur have also been transferred.

The female progeny of the Bengal-Thar-Parkar cross will in future be mated with an Ayrshire bull with a view to raising stock for urban dairies.

The only farm in ASSAM where cattle improvement receives some attention is the Upper Shillong farm. The herd of Patna cows maintained there have proved good dairy animals for the hills, but the male progeny are not considered to be sufficiently hardy for work in the plains.

The Veterinary Department in BURMA to whom the cattle-breeding work has been re-transferred, proposes to establish a stud farm at Tatkon. The small herd of Scindi cattle established at the Mandalay college, mainly for teaching purposes, is doing well.

There are nine cattle-breeding and two dairy farms in the CENTRAL PROVINCES, where herds of all the distinct breeds found in the province are being graded up by crossing with Sahiwal bulls. On one farm, however, a pure Malvi herd is being maintained and on another a pure Gaolao herd with the object of supplying pure bred bulls of these breeds which are greatly in demand for draught purposes. The success of the Sahiwal-Gaolao cross led to the definite adoption of the present policy, and it is finding further justification in the young Sahiwal-Malvi animals which are reported to be of the desired type. There is a keen demand for cattle bred by the department; 269 animals, including 50 bulls, were sold from Government farms during the year under review. The 13 pure Gaolao bulls sold from the Garhi farm fetched an average price of Rs. 300 per head. The scheme for subsidizing cattle-owners who are willing to maintain stud bulls for the public good has made a fair start; 24 premia were granted during the year. As the Government farms could not supply all the bulls required, some were allowed to be purchased from private breeders. The scheme thus acts as a stimulus to private breeding farms, the number of which is 18 in the Western Circle alone.

The BOMBAY PRESIDENCY is fortunate in having several good indigenous cattle breeds. The department is concentrating on the work of building up first class pure herds of these breeds

with a view to supplying pedigree bulls for distribution. The breeds at present dealt with are the Kankrej at Chharodi and Surat, the Amrit Mahal at Bankapur, and the Scindi and Thar-Parkar at Karachi. The department is also subsidizing the Shirpur Taluq Agricultural Association in Khandesh, which has raised during the last few years a good herd of Tapti-Khillari cattle, and two *gowshalas* in the Thana District which have agreed to maintain herds of pure Gir cattle. Premium bulls from all these sources are made available to the public; their number at present is 63.

The MADRAS Government having taken over the Hosur Remount Depôt is converting it into the central cattle farm for the presidency. The acquisition of this farm which comprises some 1,600 acres of excellent pasture lands with buildings sufficient to house nearly a thousand head of stock, will enable investigations to be made into problems of cattle-breeding and dairying on a scale proportionate to their importance. Hosur, working in close conjunction with Coimbatore, will deal with the local Kangayam breed of cattle and with the improvement of milch cows by crossing and selection; while the Chintaladevi and Guntur farms will concentrate on the breeding of Ongole cattle and buffaloes respectively.

At the Rayenkere dairy farm in MYSORE, the local Hallikar and Scindi cows are being crossed with Holstein bulls. While the Holstein-Scindi cross is considerably superior in milk yield, the Hallikar half-breds are more keenly sought after as draught cattle.

Two cattle-breeding farms are maintained in the TRAVANCORE State, from which 59 calves, chiefly of the Scindi breed, were sold during the year. Grants were made to 17 private persons who are maintaining stud bulls for the benefit of the public.

In BARODA, herds of Gir cattle and Jafferabadi buffaloes are being built up. A Cattle Committee has been appointed by the Durbar.

Sheep-breeding. Experiments are in progress in some provinces, especially in North-West India, to grade up the indi-

genous sheep by cross-breeding with Merino and other superior wool breeds. Results hitherto obtained are by no means discouraging so far as wool is concerned. It is hoped that the graded up progeny will to a certain extent combine weight of wool with carcase production.

On the Hissar farm in the PUNJAB, local sheep are crossed with Merino rams imported from Australia, and both the male and female progeny are greatly in demand. During the year under report, 20 cross-bred rams and 16 ewes were sold to private breeders. Experience has shown that the best results are obtainable only by issuing rams and ewes to sheep-breeding societies, of which the number at present is four. Two of these are in the Attock District and one each in Jhelum and Jhang.

Sheep-breeding operations in the NORTH-WEST FRONTIER PROVINCE are being handicapped by the failure of the district boards to supply Merino rams for which there is a demand. The cross-bred progeny from the local Hashtnagari ewes and fat-tailed Pusht-i-Koh rams on the Tarnab farm are a distinct improvement on the Hashtnagari breed as regards both fleece and mutton.

The improvement in clip of wool resulting from crossing with Merino rams has been very striking in MYSORE. The Kolar Sheep Breeders' Association which carries on systematic breeding with half-bred Merino rams has got together good white cross-bred flocks.

Owing to financial stringency and paucity of staff sheep-breeding in India has not received from the Department of Agriculture attention commensurate with its importance. There is an ever-increasing demand for wool in India, but the hairy stuff produced by our country breeds of sheep is suitable only for the manufacture of coarse blankets.

CHAPTER IX.

PUBLICATIONS OF THE AGRICULTURAL DEPARTMENTS.

A complete list of agricultural publications issued during the year under review is given in Appendix X (pp. 142—162). Briefly summarized, those issued by the Imperial and Provincial Departments of Agriculture are as follows :—

Imperial. Seventeen memoirs, five bulletins and five other publications were issued during the year, while 19 publications were in the press on 30th June, 1925. The publications issued dealt with subjects of general importance such as the digestibility of Indian foodstuffs, factors determining the ripeness of sugarcane, flour phosphate as a manure for paddy, eradication of the weed *Cyperus rotundus*, inheritance of characters in Roselle, nitrogen fixation in soils of the Punjab, tamarind as a source of alcohol, bud and boll shedding in cotton and siloed *shisham* leaves as fodder for dairy cows.

" The Agricultural Journal of India," which is issued every two months, continues to maintain its popularity among the class of readers for which it is intended. The Editor proposes to increase its usefulness by giving in future more prominence to various aspects of animal husbandry and dairying with a view to stimulating interest therein.

Provincial. In addition to the regular publication of the " Poona Agricultural College Magazine " and the vernacular journals of the agricultural associations, seven bulletins and two leaflets with their vernacular versions were issued in BOMBAY.

The MADRAS Agricultural Department prepares a monthly digest of the operations of the department in English and three principal vernaculars of the presidency for circulation among agriculturists. The other popular medium for bringing the work of the department to the notice of the cultivator is The Village Calendar, of which over 81,000 copies were printed in

five languages. "The Journal of the Madras Agricultural Students Union" had another successful year.

The English edition of the quarterly Journal of the BENGAL department is now conducted on a self-supporting basis. Two of the bulletins published during the year, are intended to give the literate public a concrete idea of the good work hitherto done by the department.

Among the publications of the BIHAR department was a leaflet on the preparation and utility of ensilage.

In the UNITED PROVINCES, the publication of "The Old Boys' Magazine of the Cawnpore College" and the monthly agricultural journals issued in Hindi (Kisan-Upkark) and Urdu (Mufid-ul-Mazarain) from Partabgarh was continued.

The half-yearly "Seasonal Notes" started in the PUNJAB last year to convey in a simple form useful information and advice on agricultural matters, has met with public approval. The occasional publications included leaflets on the control of field rats and the mango hopper.

All the 49 leaflets issued in previous years have been revised and reprinted in BURMA. It is proposed to issue them, together with four new leaflets published this year, in book form both in English and Burmese, as they deal with almost all aspects of agriculture in the province. The Agricultural Calendar was published in Burmese as usual, and about 6,500 copies were distributed.

In ASSAM, a pamphlet in Assamese on cattle improvement was brought out.

CHAPTER X.

RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL DEPARTMENTS.

The total expenditure incurred by the Imperial Department of Agriculture during the financial year ending 31st March, 1925, was Rs. 8,36,699 as against Rs. 8,32,129 during the previous year. The gross receipts of the Agricultural Research Institute, Pusa, from sale of publications, farm produce, milk and other articles amounted to Rs. 53,502 as against Rs. 36,421 last year. The details of expenditure are given below:

	Rs.
General expenditure of the Pusa Institute (including the office of the Agricultural Adviser and Director)	3,05,198
Botanical Section	38,124
Chemical Section	49,721
Bacteriological Section	66,656
Mycological Section	44,820
Entomological Section	68,926
Agricultural Section	1,24,997
Sugar Bureau	36,942
Imperial Dairy Expert	38,387
Physiological Chemist	62,928
TOTAL	8,36,699

The receipts and expenditure of the three dairy farms under the control of the Imperial Dairy Expert were Rs. 3,34,327 and Rs. 3,90,486, respectively, for the financial year 1924-25 as detailed below:

Name of farm	Receipts	Expenditure
	Rs.	Rs.
Bangalore	1,76,001	1,89,915
Wellington	86,408	88,023
Karnal	71,918	1,12,548
TOTAL	3,34,327	3,90,486

The following tabular statement shows the receipts and expenditure of the Provincial Departments of Agriculture for the year 1924-25. The respective figures for the previous year were Rs. 20,97,396 and Rs. 92,62,842.

Name of Province	Receipts	Expenditure
	Rs.	Rs.
Bengal	1,66,158	8,61,410
Bihar and Orissa	68,088	4,81,629
United Provinces	3,64,546	17,73,915
Punjab	4,86,736	14,00,886
Bombay	3,28,200	15,80,966
Madras	2,51,500	13,72,179
Central Provinces	3,11,440	8,83,936
Burma	62,851	8,28,035
Assam	66,959	2,72,768
North-West Frontier Province	35,140	70,112
Baluchistan	13,437	11,207
TOTAL	21,55,055	95,37,043

Speaking on the subject of agricultural development in India and of the obstacles that stand in the way of progress, the Secretary of State for India said, "Making all allowances for these difficulties, I would desire to make my opinion plain that a future of incalculable prosperity awaits India if and when she learns fully to realize and to value her agricultural kingdom." His Excellency the Viceroy, speaking on the same subject, referred to the striking progress made in recent years in promoting the science of agriculture and introducing improvements in India, and drew attention to the paramount importance of agriculture as the basic industry of the people of India, and to the

necessity for co-ordinating activities in the wide field of agricultural development in the various provinces.

Prominent non-officials, too, have, while acknowledging the excellence of the work done by the department, laid much stress on the need for more co-ordination and research. The Associated Chambers of Commerce at their meeting held in Calcutta last December passed a resolution to the effect that the Association recognized that the prosperity of trade and industry depended to an overwhelming degree upon the purchasing power of the people; that such purchasing power could not be increased materially except by the development of agricultural productivity in India, and that the Association welcomed the decision of the Government of India to co-ordinate the activities of agricultural development in the various provinces. It was further urged that the Central Government should take steps to co-ordinate the various activities of Agricultural Departments in this country and make provision for agricultural research as had been done by the Federal Government in America where, despite the independence of the various States, it has been found necessary to maintain the strongest Central Department of Agriculture in the world. The same idea has still more recently been stressed by another commercial magnate in this country. But the fact remains that the direct responsibility of the Government of India for agricultural development in the provinces ceased with the inception of the Reforms—from which time co-ordination between the Imperial and Provincial Departments of Agriculture has become increasingly difficult. How to solve this difficulty is one of the urgent problems awaiting solution.

"Perfect agriculture is the true foundation of trade and industry; it is the foundation of the riches of States" we are told. A net expenditure of Rs. 82,21,344 in 1924-25 on the Imperial and Provincial Departments of Agriculture hardly indicates that the truth of this maxim is as yet fully realized in India, where the net expenditure on agricultural development is not even equal to the subsidy which the Government of India have to pay to the Steel Industry under the Steel Industry (Protection) Act.

APPENDIX I.

Areas under new and improved varieties of crops during the year 1924-25.

Name of Province	Name of crop	Advantages	Area in acres						Remarks
			1924-25			1923-24			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Bengal	Paddy (Kataktara, Indrasail and Nagra).	Heavy yield	20,094	100,725	120,819	20,030	156,255	176,285	
	Jute (Green *olitorius*, Kakya Bombai, It. 85 and D. 154).	Give finer quality and greater quantity of fibre.	97,100	200,672	297,772	35,825	173,608	209,433	
	Sugarcane (Tanna)	Yields greater quantity of *gur*	20,603	5,070	25,673	5,400	14,600	20,000	
	Groundnut	Yields handsome profit	...	5	5	150	475	625	
	Wheat (Pusa 12)	Has good milling qualities	5	10	15	41	200	241	
	Potato (Darjeeling, Naini Tal and Shillong).	Better yield	9	75	84	62	8,851	8,913	
Bihar and Orissa	Paddy (Dahia. Types I, II & I'I and C. P. Lecchai).	Earliness and heavy yielders	1,799	24,062	25,861	1,110	10,485	11,595	
	Tobacco (Pusa 28)	.....	5	...	5	...	...	...	
	Sugarcane (Coimbatore, Mungo and Java 213.)	Greater outturn in actual cane and sugar per acre.	46	5,987	6,033	425	2,304	2,729	In addition, 5,000 acres are reported under Coimbatore canes by the Sugar Bureau.
	Groundnut (No. 17)	Profitable crop even on poor lands	41	1,933	1,974	40	530	570	
	Soybean, Black mottled, Java	An early fodder crop	...	...	...	5	10	15	
	Gram (No. 4)	Prolific yielder	28	...	28	...	..	...	
	Wheat (Pusa 4, 12)	Prolific yielder	89	345	434	...	...	238	
	Dhaincha	Economical green manure for paddy lands	101	6,007	6,108	..	2,500	2,500	

Areas under new and improved varieties of crops during the year 1924-25—contd.

Name of Province	Name of crop	Advantages	Area in acres						Remarks
			1924-25			1923-24			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
United Provinces	Wheat (Pusa 4, 12, Cawnpore 13, Muzaffarnagar).	High yielding, rust resisting	24,623	750,000	774,623	21,067*	687,000*	708,067*	*Revised figures.
	Cotton (Cawnpore-American, J. N. 1, Aligarh white-flowered and K. 23).	Superior to *desi* cotton, better lint and higher ginning percentage.	10,750	30,293	41,052	10,206	21,230	31,436	Besides, there are 87,000 acres under improved crops, details of which are not available.
	(Sugarcane (S. 29, 50 and 48; A. 42, 37; Co. 213, 214; Uba; Barbados; and Mauritius).	Give more outturn of cane per acre and 50 per cent. of *gur* more than the local canes.	5,165	12,602	17,767	1,486	9,587	11,073	
	Barley	Better yielder than local varieties	17,078	...	17,078	10,066	...	10,066	
	Gram	Produce and quality better than local varieties.	19,830	7,007	26,837	19,461	4,166	23,627	
	Miscellaneous	Better yielders than local varieties	29,578	5,968	35,546	30,261	8,043	38,304	
Punjab	Wheat (Punjab 11, 17, 8a, Pusa 4 & 12).	More yield, fetch better price, possess good milling and baking qualities, ripen early.	68,426	1,074,640	1,143,066	49,358	956,407	1,005,765	
	Cotton—								
	American 4 F	Long-stapled variety which yields more than *desi* cottons. Fetches a premium of Rs. 3—6 per maund of seed-cotton.	224,120	812,713	1,036,833	...	...	582,000	
	American 285 F	Spins finer than 4 F. and also more drought resistant and earlier.	7,195	2,636	9,831	15,750	5,500	21,250	
	Desi No. 24	Improved *desi* variety	22,667	8,604	31,271	18,000	3,000	21,000	
	White-flowered Neglectum.	More yield and higher lint percentage	21,548	35,672	57,220	24,800	18,904	43,704	
	Sugarcane (Bihar and Coimbatore 205).	High yield	518	8,318	8,836	96	6,589	6,685	

Bombay	Cotton—							
	1027 A. L. F.	The lint is sold at a premium	160,000	225,000	385,000	112,485	205,000	317,485
	Neglectum roseum	Heavy yield, pure type, better ginning percentage.	43,605	40,000	83,605	20,815	275,000	295,815
	Dharwar Nos. 1 & 3	Give increased profit	93,257	30,000	123,257	74,063	20,000	94,063
	Gadag No. 1	Give increased profit	119,632	80,000	199,632	65,044	40,000	105,044
	American	Prolific, early and hardy	12,000	9,000	21,000	16,000	1,000	17,000
	Desi 27 W. N.	Prolific, special rough feel, bright colour	5,454	1,000	6,454	3,672	...	3,672
	Groundnut	Gives increased profit, matures early	15,267	229,800	245,067	50	157,362	157,412
	Sugarcane (Red Mauritius).	Gives about 15 per cent. better yield with the advantage of ratoon crops.	50	1,541	1,591	120	1,500	1,620
	Bajra (Akola variety)	Better quality grain and higher yield	600	...	600	500	49,000	49,500
	Wheat (Pusa 4 and 12)	Better yield and less affected by smut	2,200	10,550	17,750	3,524	8,076	11,600
	Rice (various selected strains of Kolamba).	Higher yielding capacity	4,077	4,475	8,552	8,050	4,125	12,175
Madras	Paddy	Better yielders and more profitable to cultivators.	8,025	97,118	105,143	163,269	2,900	166,169
	Sugarcane	Do. do.	1,615	12,967	14,582	5,450		5,450
	Cotton	Do. do.	67,955	371,755	439,710	198,525	65,000	263,525
	Miscellaneous	Do. do.	22,390	49,431	71,821	9,031	36,300	46,231
Central Provinces	Wheat	Better yielders	...	...	104,232	...	...	62,473
	Paddy	Do.	...	...	118,865	...	...	95,577
	Cotton	Do.	...	...	571,350	...	...	545,040
	Juar	Do.	...	...	59,073	...	...	69,942
	Groundnut	Do.	...	...	12,552	...	...	11,599
	Other crops	Do.	...	...	5,666	...	...	4,222

Areas under new and improved varieties of crops during the year 1924-25—concld.

Name of Province	Name of crop	Advantages	Area in acres						Remarks
			1924-25			1923-24			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Burma	Paddy	Uniformity and freedom from red grain. High milling capacity.	...	...	187,612	...	...	137,947	
	Groundnut	High oil capacity. Earlier. Easy to harvest	...	...	10,741	...	...	8,888	
	Cotton (Indigenous selection and Cambodia).	More profitable to cultivate	...	...	5,232	..	...	6,348	
	Gram	Immunity to wilt disease	...	...	22,466	...	...	31,100	
Assam	Paddy	Higher yielders than *desi* varieties	1,130	1,926	3,056	1,693	2,162	3,855	
	Jute		554	1,194	1,748	596	233	829	
	Sugarcane		26	226	252	797	...	797	
	Potato		213	206	419	158	79	237	
North-West Frontier Province.	Wheat (Pusa 4)	Ripens early, does not lodge, resists rust	...	...	202,000	...	...	202,000	
	Sugarcane (Red Assami)	Ripens early, vigorous in growth, little affected by disease or borers.	...	...	600	...	...	500	
	Berseem	Yields better than shaftal	...	...	5,000	...	...	2,500	

APPENDIX II.

List of Agricultural Stations in British India in 1924-25.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bombay	Surat	292	Superintendent	Deputy Director of Agriculture, Gujarat, Surat.	
	Amalsad	19	Overseer		
	Nadiad	44	Tobacco Breeder		
	Broach	6	Cotton Breeder, South Gujarat.		
	Dohad	57	Superintendent		
	Viramgam	6	Cotton Breeder, North Gujarat.		
	Dhulia	24	Headmaster, Vernacular Agricultural School.	Deputy Director of Agriculture, North Central Division, Nasik.	
	Jalgaon	205	Superintendent		
	Kopargaon	115	Ditto	Deputy Director of Agriculture, South Central Division, Poona.	Mainly a fodder farm for famine use. (A small portion is utilized as a sugarcane station.)
	Mohol	49	Overseer		
	Baramati	21	Ditto		Sugarcane farm.
	Manjri	62	Ditto		Sugarcane experimental station.

List of Agricultural Stations in British India in 1924-25—contd.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bombay—*concld.*	Dharwar	134	Superintendent	Deputy Director of Agriculture, Southern Division, Dharwar.	
	Gokak Canal	62	Ditto		
	Mugad	9	Ditto		
	Tegur	370	Fieldman		
	Chharodi	2,251	Manager	Live Stock Expert to Government, Bombay, Poona.	Cattle-breeding farms.
	Bankapur	112	Ditto		
	Karachi (Lord Willingdon Cattle Farm).	800	Ditto		
	Ratnagiri	102	Superintendent	Deputy Director of Agriculture, Konkan, Ratnagiri.	
	Kumta	20	Ditto		
	Karjat	7	Rice Specialist		Rice research station.
	Karjat	7	Superintendent	Crop Botanist to Government, Bombay, Poona.	Ditto.
	Mirpurkhas	200	Ditto	Deputy Director of Agriculture, Sind, Karachi.	Seed farm.
	Mirpurkhas	60	Ditto		
	Sukkur	30	Ditto		
	Larkana	65	Ditto		Utilized as an adjunct to the Lord Willingdon Cattle Farm near Karachi.
	Jacobabad	300	Ditto		Wheat farm.

	Ganeshkhind, Kirkee	80	Ditto	Horticulturist to Government, Poona.	Agricultural and botanical station. Horticultural course is given here.
	Modi Bag, Poona	11	Ditto		Teaching garden.
	Poona	289	Ditto	Professor of Agriculture, Poona Agricultural College.	Agricultural College farm.
	Kirkee	302	Manager		Agricultural College dairy.
Madras	Coimbatore	440	Ditto	Superintendent, Central Farm, Coimbatore.	Central farm attached to the Agricultural College.
	Samalkota	57	Ditto	Deputy Director of Agriculture, I Circle, Vizagapatam.	
	Anakapalli	41	Ditto		
	Guntur	150	Ditto	Deputy Director of Agriculture, II Circle, Guntur.	
	Hagari	225	Ditto	Deputy Director of Agriculture, III Circle, Bellary.	
	Nandyal	102	Ditto		
	Palur	64	Ditto	Deputy Director of Agriculture, IV Circle, St. Thomas's Mount.	
	Koilpatti	125	Ditto	Deputy Director of Agriculture, VI Circle, Madura.	
	Kasargod	106	Ditto	Deputy Director of Agriculture, VII Circle, Tellicherry.	West Coast coconut station.
	Taliparamba	86	Ditto		
	Nanjanad, The Nilgiris	36	Ditto	Deputy Director of Agriculture, VIII Circle, Coimbatore.	Seed potato farm.

List of Agricultural Stations in British India in 1924-25—contd.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Madras—*concld.*	Tenmalai (Travancore)	20	Manager	Deputy Director of Agriculture, Planting Districts, Coimbatore.	Rubber stations.
	Mooply (Cochin)	20	Ditto		
	Sidapur (Coorg)	19	Ditto		Coffee station.
	Peermade (Travancore)	20	Ditto		Tea station.
	Chintaladevi	850	Ditto	Deputy Director of Agriculture, Live stock, Hosur.	Cattle farm.
	Coonoor	...	Assistant Farm Manager	Curator, Government Botanic Gardens, Ootacamund.	Pomological station.
	Hosur	1,635	Farm Manager	Deputy Director of Agriculture, Live-stock.	Central cattle farm.
	Dacca	354	Chief Superintendent	Deputy Director of Agriculture, Eastern Circle.	
	Mymensingh	20	District Agricultural Officer.		
	Faridpur	20	Ditto		
	Comilla	20	Ditto		
	Barisal	20	Ditto		
	Jamalpur (Mymensingh)	7	Ditto		
	Dhanbari	21			
	Kishoregunj	200	Ditto		
	Rajshahi	63	Superintendent		
	Rangpur	333	Ditto		Cattle farm

Bengal	Rangpur	19	District Agricultural Officer	Deputy Director of Agriculture, Northern Circle.	Demonstration farm.
	Burirhat (Rangpur)	52	Superintendent		Tobacco farm.
	Bogra	23	District Agricultural Officer		
	Pabna	20	Ditto		
	Chinsura	210	Chief Superintendent	Deputy Director of Agriculture, Western Circle.	
	Burdwan	32	District Agricultural Officer		
	Jessore	20	Ditto		
	Gosaba	10	Superintendent	Deputy Director, Western Circle, and Superintendent, Burdwan Division.	
	Berhampore	45	District Agricultural Officer		
	Bankura	29	Ditto		
	Suri	33	Ditto		
	Kalimpong	76	Manager	Director of Agriculture, Bengal.	
	Kalimpong, Kurseong and Berhampore.	...	Superintendent of Sericulture.	Deputy Director of Sericulture.	Sericultural research stations.

List of Agricultural Stations in British India in 1924-25—contd.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bihar and Orissa	Sabour	190	Probationary Assistant Director of Agriculture.	Director of Agriculture.	
	Jamui	38	Inspector	Assistant Director of Agriculture.	
	Banka	26	Overseer	Ditto	
	Monghyr	200	Superintendent	Director of Agriculture.	Dairy farm.
	Gaya	193	Manager	Deputy Director of Agriculture, Patna Circle, Patna.	
	Nawada	67	Inspector		
	Bikramganj	24	Overseer		
	Kanke	340	Manager	Deputy Director of Agriculture, Chota Nagpur Circle, Kanke, Ranchi.	
	Netarhat	193	Ditto		Potato farm.
	Purulia	52	Inspector		
	Ramgarh	43	Overseer		
	Chianki	32	Ditto		
	Sambalpur	32	Inspector		
	Chaibassa	33	.....		
	Cuttack	150	Assistant Director of Agriculture.	Deputy Director of Agriculture, Orissa Circle, Cuttack.	
	Khurda	31	Manager		
	Balasore	75	Overseer		

United Provinces	Angul	47	Ditto		
	Puri	42	Ditto	Deputy Director of Agriculture, North Bihar Range.	Cattle-breeding farm and sugarcane station.
	Sepaya	379	Probationary Assistant Director of Agriculture		
	Cawnpore	71	Superintendent	Deputy Director of Agriculture, Central Circle, Cawnpore.	
	Kalianpur (Cawnpore)	263	Ditto		
	Atarra (Banda)	171	Ditto		
	Etawah	62	Ditto		
	Hardoi	40	Ditto		
	Mainpuri	53	Ditto		
	Jaitpur (Hamirpur)	31	Overseer		
	Partabgarh	90	Superintendent	Deputy Director of Agriculture, Eastern Circle, Partabgarh.	
	Naugawan (Sultanpur)	386	Ditto		
	Lucknow (Sullage Farm)	75	Ditto		
	Fyzabad	206	Ditto		
	Rae Bareilly	12	Ditto		
	Benares	78	Ditto		
	Aligarh	88	Ditto	Deputy Director of Agriculture, Western Circle, Aligarh.	
	Muzaffarnagar	109	Ditto		
	Muttra	36	Inspector		
	Agra	100	Ditto		
	Bulandshahr	25	Ditto		
	Aligarh (Kalai)	142	Superintendent		

List of Agricultural Stations in British India in 1924-25—contd.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
United Provinces—*concld.*	Gorakhpur	110	Overseer	Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur.	
	Bahraich	21	Ditto		
	Shahjahanpur	164	Deputy Director of Agri.	Deputy Director of Agriculture, Rohilkhand Circle.	
	Jeolikot (Naini Tal)	52	Inspector		
	Nawabganj (Bareilly)	119	Ditto		
Punjab	Lyallpur—				
	Agricultural Farm	473	Manager	Professor of Agriculture, Punjab, Lyallpur.	
	Students' Farm	78			
	Botanical Farm	120	Assistant to Economic Botanist.	Economic Botanist to Government, Punjab, Lyallpur.	
	Montgomery	250	Manager	Professor of Agriculture, Lyallpur, and Extra Assistant Director of Agriculture.	Mainly a seed farm.
	Gurdaspur	161	Ditto	Duputy Director of Agriculture, 1st Circle.	Experimental station.
	Sargodha	657	Ditto		Ditto and seed farm.
	Chillianwalla	250	Ditto		Seed farm.
	Beas	43	Ditto		Demonstration farm.
	Hansi	589	Ditto	Deputy Director of Agriculture, 2nd Circle.	Experimental Station.
	Multan	530	Ditto	Deputy Director of Agriculture, Multan.	Being acquired.
	Harappa Road	560	Ditto	Deputy Director of Agriculture, Lyallpur.	For reclamation of saline soils.
	Mandalay	619	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, Northern Circle.	
	Padu	29	Senior Agricultutal Assistant.		

Burma	Tatkon	45	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, East Central Circle.	
	Yawnghwe	36	Ditto		
	Mahlaing	244	Superintendent, Assistant Director of Agriculture.	Deputy Director of Agriculture, Myingyan Circle.	
	Taungtha	16	Junior Agricultural Assistant.		
	Allanmyo	143	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, West Central Circle.	
	Pwinbyu	22	Junior Agricultural Assistant.		
	Hmawbi	454	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, Southern Circle.	
	Nyaunglebin	16	Junior Agricultural Assistant.		
	Zigon	21	Ditto		
	Akyab	128	Superintendent, Senior Agricultural Assistant.	Deputy Director of Agriculture, Arakan Circle.	
	Kyaukpyu	23	Ditto		
Central Provinces	Nagpur	268	Superintendent	Principal, Agricultural College, Nagpur.	College farm.
	Akola	271	Ditto	Economic Botanist, Nagpur.	
	Borgaon	368	Ditto	Deputy Director of Agriculture, Western Circle, Amraoti.	
	Yeotmal	106	Ditto		
	Khandwa	177	Ditto		
	Basim	109	Ditto		

List of Agricultural Stations in British India in 1924-25—concld.

Name of Province	Name of Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Central Provinces — *concld.*	Sindewahi	197	Superintendent	Deputy Director of Agriculture, Southern Circle, Nagpur.	
	Tharsa	116	Ditto		
	Wara-Seoni	63	Ditto		
	Telinkheri	1,000	Ditto	Deputy Director of Agriculture in charge Animal Husbandry, Nagpur.	Dairy farm.
	Raigarh (Garhi)	1,200	Ditto		Cattle-breeding farm.
	Chandkhuri	333	Ditto	Deputy Director of Agriculture, Eastern Circle, Raipur.	
	Bilaspur	253	Ditto		
	Drug	281	Ditto		
	Raipur	229	Ditto		
	Powarkhera (Hoshangabad)	528	Ditto	Assistant Director of Agriculture, Chhindwara.	
	Seoni	164	Ditto		
	Chhindwara	69	Ditto		
	Betul	161	Ditto		
	Adhartal (Jubbulpore)	637	Ditto	Deputy Director of Agriculture, Northern Circle, Jubbulpore.	
	Saugor	161	Ditto		
	Damoh	152	Ditto		

Assam	Jorhat	59	Manager	Deputy Director of Agriculture, Assam.	Sugarcane station.
	Titabor	120	Ditto		Rice station.
	Upper-Shillong	367	Ditto		Potato station.
	Karimganj	80	Ditto		Rice station.
North-West Frontier Province.	Tarnab (Peshawar)	200	Ditto	Agricultural Officer, North-West Frontier Province, Tarnab.	
	Haripur	20	Ditto		
Imperial Department of Agriculture.	Pusa	616	Overseer	Imperial Agriculturist.	
	Bangalore	258	Superintendent	Imperial Dairy Expert.	
	Wellington	69	Ditto		Dairy farms.
	Karnal	2,154	Ditto		

APPENDIX III.

Showing results of well-boring during 1924-25.

Name of Province	1924-25		1923-24	
	Number of bores	Number successful	Number of bores	Number successful
United Provinces	656	447	508	471
Punjab	238	188	248	208
Bombay	164	104	197	127
Madras	690	433	625	354
Central Provinces	...	...	12	7
Bengal	11	10	5	5
Bihar and Orissa	120	111	71	71

APPENDIX IV.

Showing sale of improved implements through departmental agency during 1924-25.

Name of Province	Ploughs		Cane mills		Fodder cutters		Hoes		Other implements		Spare parts	
	1924-25	1923-24	1924-25	1923-24	1924-25	1923-24	1924-25	1923-24	1924-25	1923-24	1924-25	1923-24
United Provinces .	2,633	1,422	105	95	37	27	5	44	221	164	4,701	2,818
Punjab . . .	5,329	8,415	6	220	941	533	52	45	5,086	1,274	2,451	1,739
Bombay . . .	2,470	987	12	60	11	4,872	39	25	130	113	195	263
Madras . . .	1,834	1,341	11	63	41	5	2	23	488	271	2,681	834
Central Provinces .	7,672	7,966	192	107	41	36	462	339	463	296	4,218	3,186
Bengal . . .	9	18	6	15	...	...	1	...	8	4	...	...
Bihar and Orissa .	...	...	2	...	...	...	...	...	2	...	...	...
Assam . . .	8	1	231	182	...	...	6	...	71	75	16	...
Burma . . .	596	57	...	6	...	...	...	...	191	32	...	359
North-West Frontier Province.	...	20	...	..	...	...	...	...	...	...	...	50

APPENDIX V.

Agricultural Colleges and Schools in British India during 1924-25.

Name of College or School	Courses of Instruction	1923-24				1924-25				Remarks
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
1	2	3	4	5	6	7	8	9	10	11
					(a) Post-graduate Training Institutions.					
Agricultural Reserch Institute, Pusa.	(1) Post-graduate (New Course).	40	2	2	...	32	6	5	...	In addition 10 students received short courses of training in 1924-25.
	(2) Special Course	...	1	7	4	...	...	3	3	
Imperial Institute of Animal Husbandry and Dairying, Bangalore.	(1) Post-graduate course in animal husbandry and dairying—15 months.	...	5	5	...	21	2	7	5	
	(2) Indian Diploma course in dairying (2 years).	190	16	16	...	...	...	13	...	
	(3) Short course in animal husbandry and dairying for varying periods.	3	3	3	3	7	7	7	4	
					(b) Provincial Agricultural Colleges.					
Poona Agricultural College.	(1) Three-year B. Ag. Degree course.	93	70	70	45	93	75	70	59	Affiliated to the University of Bombay.
	(2) College Diploma course.				...					

Agricultural College, Coimbatore.	(1) Degree course—3 years.	68	7	32	8	49	20	39	12	Affiliated to the University of Madras.
	(2) Certificate course—2 years.	61	12	34	20	...	...	9	9	
Agricultural College, Nagpur.	(1) Three and half year's Diploma course for the Licentiate of Agriculture.	89	65	54	3	107	50	76	5	
	(2) Two years' certificate course.	26	12	21	13	37	17	25	5	
Agricultural College, Cawnpore.	(1) Diploma (L.Ag.) course of 4 years.	48	21	68	11	51	21	69	16	
	(2) Two years' or vernacular course.	80	24	49	20	80	27	47	18	
Punjab Agricultural College, Lyallpur.	(1) B.Sc. Agri. course—4 years. (2) M.Sc. Agri. course . (3) Leaving Certificate course—2 years.	180	53	148	30	140	64	170	24	Affiliated to the University of Punjab.
	(4) Vernacular course—6 months.	28	17	17	11	66	52	22	19	
	(5) Rural Economy course—1 month.	28	24	24	24	15	15	15	15	
	(6) Teachers' Training course—10½ months.	9	9	9	9	32	30	26	26	
Agricultural College and Research Institute, Mandalay.	Three years' Diploma course; two years' Certificate course.	143	24	24	...	36	18	31	13	Certificate course has been abolished.
Bengal.				*(c) Agricultural High and Middle Schools.*						
Secondary Agricultural School, Dacca.	The new curriculum includes agriculture, rural engineering, veterinary hygiene, book-keeping and rural economics.	57	14	12	5	23	6	14	7	

Agricultural Colleges and Schools in British India during 1924-25—contd.

Name of College or School	Courses of instruction	1923-24				1924-25				Remarks
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
1	2	3	4	5	6	7	8	9	10	11
Bengal—concld.				(c) *Agricultural High and Middle Schools*—contd.						
Bimala Agricultural High English School, Amarpur, District Burdwan.	Students are taught agriculture, both theoretical and practical, from class V to X.	80	62	212	...	75	63	211	9	
Durgapur High English School, District Chittagong.	Ditto . .	16	16	48	20	15	15	60	40	
Central Provinces.										
Agricultural Middle School, Powarkhera.	2 years' course . .	...	21	18	6	...	23	22	8	
Agricultural Middle School, Chandkhuri.	Ditto . . .	...	11	8	2	...	...	3	3	The school has now been closed.
Madras.										
Agricultural Middle School, Taliparamba.	2 years' course in vernacular.	25	14	31	14	33	27	34	13	
Agricultural Middle School, Anakapalli.	Ditto . .	6	6	11	5	50	29	21	6	

Burma.										
Agricultural School, Pyinmana.	4 years' course . .	...	35	57	22	...	27	62	35	The school is run by the American Baptist Mission and subsidized by Government.
Central Farm School, Hmawbi	One week class . .	...	...	...	...	...	...	80	...	
Central Farm School, Mahlaing.	Short course of practical instruction.	...	...	...	...	...	...	31	...	
Bombay.										
Vernacular Agricultural School, Lonikalbhor (in Marathi).	2 years' course . .	61	18	39	19	73	24	42	16	
Vernacular Agricultural School, Devihosur (in Kanarese).	Ditto . .	50	14	24	8	58	15	25	12	Practical training in weaving, rope making, etc., is also given.
Vernacular Agricultural School, Jambul (in Marathi).	Ditto . .	18	14	17	6	35	18	21	5	
Vernacular Agricultural School, Godhra (in Gujarati).	Ditto . .	50	18	31	13	60	17	31	13	
Vernacular Agricultural School, Dhulia, West Khandesh (in Marathi).	Ditto . .	36	18	28	No exam.	37	22	22	8	
Vernacular Agricultural School, Surat (in Gujarat).	Ditto . .	19	13	13	Ditto	32	17	26	13	Started during 1923-24.

Agricultural Colleges and Schools in British India during 1924-25—concld.

Name of College or School	Courses of instruction	1923-24				1924-25				Remarks
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
1	2	3	4	5	6	7	8	9	10	11
Bihar and Orissa.		(c) *Agricultural High and Middle Schools*—concld.								
Vernacular Agricultural School, Pathra (Godda), District Santal Parganas.	Practical training in general agriculture, spinning, etc.	24	24	40	2	33	33	40	2	Attached to the C. M. S. Mission Upper Primary School.
United Provinces.										
Vernacular Agricultural School, Bulandshahr.	2 years' course	28	19	43	22	26	19	37	23	
	Teachers' training course.	...	...	...	...	10	10	10	...	

APPENDIX VI.

Operations of Non-Credit Agricultural Co-operative Societies in British India, during 1924-25.

The two tables below include Agricultural Societies for—

A. 1. *Purchase and Purchase and Sale.* These are societies intended to facilitate the purchase of agricultural requisites for members, such as societies which purchase seed, manure, implements, etc., for sale to their members. Societies of this character which collect for joint sale the produce of members without making this their main object are also included in this class.

2. *Production.* These are societies which have for their chief object an act of production without proposing to themselves sale as a direct object. These also include societies for joint irrigation, for collective use of machinery, for assistance in horse and cattle breeding, etc.

3. *Production and Sale.* This class includes societies in which these two functions are united or in which one or the other predominates, it being impossible to make a clear distinction between them. It covers all societies whose main object is the joint sale of any commodity whether such commodity is produced or worked up or prepared for sale by the society itself or by the members individually. It comprises all co-operative creameries and distilleries, as well as societies whose main object is the sale of grain, cattle, eggs, *ghi*, etc., produced by their members.

4. Other forms of co-operation except insurance.

B. Insurance.

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1924-25.

(*A*) *Purchase, Sale and Production.*

Province	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit and loss for the year	Remarks
				Rs.	Rs.	Rs.	Rs.	
Bombay	Purchase and Purchase and Sale.	91	4,732	2,51,965	3,611	2,85,414	+5,774	
	Production	18	519	...	...	16,789	—718	
	Production and Sale	65	8,732	7,80,607	18,89,966	11,24,904	+73,839	
	Others	49	11,855	4,545	1,790	1,62,919	+20,946	
	Total	223	25,838	10,37,117	18,95,367	15,90,026	+99,841	
Madras	Purchase and Purchase and Sale.	78	8,135	2,20,868	57,007	4,83,370	—35,523	
	Production and Sale	4	359	—	—	1,45,235	—10,436	
	Others	226	13,611	—	—	1,37,146	+6,999	
	Total	308	22,105	2,20,868	57,007	7,65,751	—38,960	
Bengal	Purchase and Purchase and Sale.	33	5,337	2,96,183	1,65,947	94,449	+17,761	
	Production	268	10,368	...	...	1,90,124	—19,595	
	Production and Sale	69	6,637	12,43,181	6,06,198	6,04,662	+2,48,730	
	Others	21	325	1,048	307	8,381	—591	
	Total	391	22,667	15,40,412	7,72,452	8,97,616	+2,46,305	

ihar and Orissa.	Purchase and Sale	9	418	12,742	10	6,956	−786	* and 80,153 mds. of grain. † and profit of 12,773 mds. grain.
	Production and Sale	22	269	3,731	2,781	12,750	−4,640	
	Others (Grain Golas)	79	22,263	...	...	96,200*	−7,787†	
	TOTAL	110	22,950	16,473	2,791	115,906	−13,213	
United Provinces.	Purchase and Sale	1	72	...	...	6,793	−105	
	Production and Sale	4	137	...	3,745	15,466	+77	
	Central Supply Societies	2	280	10,648	8,367	34,149	+2,651	
	TOTAL	7	489	10,648	12,112	56,408	+2,623	
Punjab	Purchase and Purchase and Sale.	16	466	7,024	4,081	9,059	−3,270	
	Production	71	1,412	...	...	5,476	+203	
	Production and Sale	30	2,028	14,14,180	32,00,537	4,03,456	+12,793	
	Others	387	16,061	...	...	57,353	+1,833	
	TOTAL	504	19,967	14,21,204	32,04,618	4,75,344	+11,559	
Burma	Purchase and Purchase and Sale.	18	1,094	7,019	...	15,346	−2,194	
	Production	6	180	...	...	...	...	
	Production and Sale	75	9,351	1,86,147	67,085	10,03,001	−1,97,206	
	TOTAL	99	10,625	1,93,166	67,085	10,18,347	−1,99,400	

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1924-25—concld.

(A) *Purchase, Sale and Production*—concld.

Province	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit and loss for the year	Remarks
				Rs.	Rs.	Rs.	Rs.	
Central Provinces and Berar.	Purchase and Purchase and Sale.	8	794	53,030	...	47,233	+ 5,462	
	Production	16	209	1,009	...	2,127	+ 98	
	Production and Sale . .	1	205	3,089	...	10,177	+ 234	
	TOTAL .	25	1,208	57,128	...	59,537	+ 5,794	

(B) *Cattle Insurance.*

Province	Number of societies	Amount of risk insured	Premia collected during the year	Supplementary contributions collected	Number of animals		Claims paid	Cost of management	Funds in hand at end of year	Amount of risk re-insured	Amount of premia paid for re-insurance
					Insured	Lost					
		Rs.	Rs.	Rs.			Rs.	Rs.	Rs.	Rs.	Rs.
Bombay . . .	9	5,425	314	...	85	7	426	111	1,504	...	...
Punjab . . .	1	...	...	...	...	...	...	...	58	...	...
Burma . . {	397	5,619	1,604	...	1,218	63	2,550	195	37,469	26,289	768
	1*	26,289	1,185	..	2,083	101	1,203	669	15,886	...	...
United Provinces .	1	1,133	35	...	20	1	65	...	29	...	...

*Central Re-insurance Society.

APPENDIX VII.

Showing the working of the Provincial Civil Veterinary Departments during 1924-25.

Province	Reported mortality			Dispensaries and Hospitals			District work					
	Rinderpest	Other diseases	Total	Hospitals and dispensaries	Cases treated	Castrations performed	Cases treated	Castrations performed	Outbreaks in which inoculation was undertaken	Deaths un-inoculated	Inoculations	Deaths after inoculation
Bombay	36,564	4,309	40,873	89	160,780	4,752	36,038	6,066	1,053	16,975	125,903	372
Madras	9,681	20,041	29,722	76	102,887	3,007	69,822	8,005	245	4,977	29,099	59
Bengal	19,082	2,813	21,901	41	54,796	102	94,851	43	845	12,434	137,284	699
Bihar and Orissa	13,473	7,084	20,557	29	42,316	1,061	70,523	370	1,097	7,088	160,257	462
United Provinces	7,871	10,179	18,050	129	197,787	2,246	62,627	68	536	7,975	65,108	79
Punjab	31,750	17,743	49,493	179	646,333	56,905	130,551	52,527	1,435	10,185	333,610	116
Burma	14,081	4,474	18,555	5	11,196	21	145,710	...	535	4,578	63,205	380
Central Provinces	22,475	6,288	28,763	88	264,664	2,408	327,861	23,812	964	10,928	108,911	253
Assam	12,541	14,982	27,523	3	5,211	116	67,184	933	263	5,456	22,641	247
North-West Frontier Province.	810	1,168	1,978	16	52,729	3,797	41,317	28,652	73	629	16,376	26
Sind	783	4,786	5,519	16	29,574	125	4,869	23	41	664	3,380	7
Baluchistan	8	2,475	2,483	10	12,090	69	9,156	6	11	181	1,100	1
Rajputana	954	106	1,060	2	2,055	13	1,767	...	14	447	1,357	10
Total for 1924-25	170,029	96,448	266,477	683	1,582,418	74,622	1,062,276	120,805	7,112	82,517	968,431	2,711
Total for 1923-24	96,082	104,880	200,962	668	1,480,435		893,474		5,115	54,320	812,141	2,573

APPENDIX VIII.

Showing the details as to students of Veterinary Colleges and Schools in India during 1924-25.

Veterinary College or School	Course of instruction	Number of Students						Students admitted during the year, classed by educational qualifications		
		Admitted during the year		Passed final examination during the year	Failed to pass final examination	Remaining under instruction at end of the year		Matriculates, school finals or with higher qualifications	Knowing some English but not matriculates	Knowing no English or very little English
		Scholarship holders	Others			In ordinary course	Instruction prolonged by reason of failure to pass			
1	2	3	4	5	6	7	8	9	10	11
Bombay Veterinary College	3 years' English course.	15	14	17	4	33	7	14	15	...
Bengal „ „	Ditto	19	15	42	18	46	43	8	16	...
Madras „ „	Ditto	15	7	28	4	29	18	22	...	...
	Post Diploma course.	7	1	6	2	...	...	8	...	...
Punjab „ „	Ditto	4	1	1	...	5	...	5	...	...
	4 years' English course.	6	31	...	...	82	...	37	...	...
	3 years' Vernacular course.	...	...	7	...	...	...	...	...	...
Insein Veterinary School	Ditto	...	...	15	...	28	...	...	...	...
Taunggyi „ „	1½ Ditto	2	6	1	4	8	...	...	1	7

APPENDIX IX.

Showing the number of cattle issued from Government farms during 1924-25.

Province	Bulls	Cows	Male buffaloes	She buffaloes	Young stock	Total for 1924-25	Total for 1923-24	Remarks
United Provinces	54	...	25	...	...	79	78	
Punjab	296	4	...	...	140	440	366	
Bombay	27	60	...	...	89	176	66	
Madras	13	16	...	...	5	34	76	
Central Provinces	50	93	8	16	102	269	314	
Bengal	...	...	...	...	...	...	60	
Bihar and Orissa	1	3	...	...	12	16	23	
Assam	6	4	...	...	9	19	26	
North-West Frontier Province	2	...	...	...	...	2	3	
Burma	...	...	...	...	...	...	2	
Imperial Farms.								
Pusa	1	38	...	...	90	129	33	
Bangalore	...	23	...	1	61	85	16	
Wellington	...	4	...	...	39	43	27	

APPENDIX X.

List of Agricultural Publications in India during 1924-25.

No.	Title	Author	Where published
	GENERAL AGRICULTURE		
1	The *Agricultural Journal of India*, Vol. XIX, Parts IV, V and VI, and Vol. XX, Parts I, II and III. Price, R. 1-8 or 2*s.* per part; annual subscription Rs. 6 or 9*s.* 6*d.*	Edited by the Agricultural Adviser to the Government of India, Pusa.	Vol. XIX, Parts IV, V and VI Messrs. Thacker, Spink & Co., Calcutta; Vol. XX, Parts I, II and III by the Manager, Government of India Central Publication Branch, Calcutta.
2	Scientific Reports of the Agricultural Research Institute, Pusa (including the Reports of the Imperial Dairy Expert, the Physiological Chemist and the Secretary, Sugar Bureau) for 1923-24. Price, R. 1.	Issued from the Agricultural Research Institute, Pusa.	Government of India Central Publication Branch, Calcutta.
3	Review of Agricultural Operations in India, 1923-24. Price, R. 1-9.	Agricultural Adviser to the Government of India, Pusa.	Ditto
4	Birds of an Indian Garden. Price, Rs. 12.	T. Bainbrigge Fletcher, R. N., F.L.S., F.E.S., F.Z.S., Imperial Entomologist, Pusa, and C. M. Inglis, M.B.O.U., F.E.S., F.Z.S.	Messrs. Thacker, Spink & Co., Calcutta.
5	Bud and Boll Shedding in Cotton. Pusa Agricultural Research Institute Bulletin No. 156. Price, As. 14 or 1*s.* 6*d.*	G. R. Hilson, B.Sc., V. Ramanatha Ayyar, L. Ag., and R. Chokkalingam Pillai, L Ag.	Government of India Central Publication Branch, Calcutta.
6	The Experimental Sullage Farm, Lyallpur. Pusa Agricultural Research Institute Bulletin No. 157. Price, As. 12 or 1*s.* 3*d.*	P. E. Lander, M.A., D.Sc., A.I.C., Agricultural Chemist, Punjab.	Ditto
7	New Fodder (Siloed *Shisham* Leaves) for Dairy Cows. Pusa Agricultural Research Institute Bulletin No. 158. Price, As. 6 or 8*d.*	P. E. Lander, M.A., D.Sc., A.I.C., Agricultural Chemist, Punjab, and Pandit Lal Chand Dharmani, L. Ag.	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
8	Estimates of Area and Yield of Principal Crops in India, 1923-24. Price As. 9 or 1*s.*	Issued by the Department of Statistics, India.	Government of India Central Publication Branch, Calcutta.
9	Agricultural Statistics of India, 1922-23. Vol. I. Price As. 12.	Ditto	Ditto
10	Agricultural Statistics of India, 1922-23. Vol. II. Price As. 12.	Ditto	Ditto
11	Agricultural Statistics of Bengal for 1923-24.	Government of Bengal, Agriculture and Industries Department.	Bengal Government Press, Calcutta.
12	Report on the Operations of the Department of Agriculture, Bengal, for the year 1923-24. Price Rs. 3-8.	Issued by the Department of Agriculture, Bengal.	Ditto
13	Season and Crop Report of Bengal for 1924-25.	Ditto	Ditto
14	History of Experiments with improved Jute in Bengal Districts.	D. N. Maitra, District Agricultural Officer, Faridpur.	Ditto
15	Recommendation regarding Crop and Manures and Cattle. Bengal Department of Agriculture Bulletin No. 1 of 1925.	Issued by the Department of Agriculture, Bengal.	Ditto
16	Recommendation regarding Crops and Manures and Cattle. Bengal Department of Agriculture Bulletin No. 2 of 1925.	Ditto	Ditto
17	"Kachuri" (in Bengali). Bengal Department of Agriculture Leaflet No. 1.	Ditto	Ditto
18	A Short Note on Agricultural Department in Bengal (Bengali). Bengal Department of Agriculture Leaflet No. 4.	Ditto	Ditto

List of Agricultur l Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
19	Potato Cultivation (in Bengali). Bengal Department of Agriculture Leaflet No. 5.	D. N. Maitra, District Agricultural Officer, Faridpur.	Bengal Government Press, Calcutta.
20	*Bengal Agricultural Journal* (Quarterly). (In English and Bengali.) Annual subscription R. 1-4; single copy As. 5.	Issued by the Department of Agriculture, Bengal.	Sreenath Press, Dacca.
21	Report of the Department of Agriculture, Bihar and Orissa, from 1st July 1923 to 31st March 1924. Price Rs. 2-6.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Printing, Bihar and Orissa, Patna.
22	Agricultural Statistics of Bihar and Orissa, 1923-24.	Ditto	Ditto
23	Season and Crop Report of Bihar and Orissa, 1924-25.	Ditto	Ditto
24	Rural Wage Census Report, Bihar and Orissa, held during April 1924.	Ditto	Ditto
25	Leaflet on Ensilage (in English).	Ditto	Ditto
26	Annual Report on the Administration of the Department of Agriculture, United Provinces, for the year ending 30th June, 1924.	Issued by the Department of Agriculture, United Provinces.	Government Press, United Provinces, Allahabad.
27	Season and Crop Report of the United Provinces of Agra and Oudh for 1923-24.	Issued by the Department of Land Records, United Provinces.	Ditto
28	Annual Report on the Agricultural Stations in the Central Circle, United Provinces, for the year 1923-24.	Issued by the Department of Agriculture, United Provinces.	Ditto
29	Report on the Agricultural Stations of the Western Circle, United Provinces, for the year ending 31st May, 1924.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*		
30	Report on the Agricultural Stations in the Eastern Circle, United Provinces, for the year ending 31st May, 1924.	Issued by the Department of Agriculture, United Provinces.	Government Press, United Provinces, Allahabad.
31	Report on the Agricultural Stations in the North-Eastern Circle, United Provinces, for the year 1923-24.	Ditto	Ditto
32	Report on the Agricultural Stations in the Rohilkhand Circle, United Provinces, for the year ending 31st May, 1924.	Ditto	Ditto
33	Report on the Working and Administration of United Provinces Government Gardens for the year 1923-24.	Ditto	Ditto
34	Seasonal Notes for October 1924. Price, As. 3.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
35	Seasonal Notes for March 1925. Price, As. 3.	Ditto	Ditto
36	Annual Report on the Operations of the Department of Agriculture, Punjab, Part II, for the year ending 30th June 1923. Price, Volume I Rs. 3-12 and Vol. II Rs. 7-8.	Ditto	Ditto
37	Annual Report on the Operations of the Department of Agriculture, Punjab, for the year 1923-24, Part I. Price, Rs. 3.	Ditto	Ditto
38	Annual Report of the Lawrence Gardens, Lahore, for 1923-24.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
39	Proceedings of the Fifth Annual Gathering of the Old Boys' Association, Punjab Agricultural College, Lyallpur, held in March 1924 and the Scientific Papers read on the occasion (as Appendices).	T. A. Miller Brownlie, Offg. Principal, Punjab Agricultural College, Lyallpur, and President. Old Boys' Association, Punjab Agricultural College, Lyallpur.	The Indian Printing Works, Lahore.
40	"Poli" (*Carthamus Oxyacantha*).	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
41	Field Rats and their Control. Punjab Department of Agriculture Leaflet No. 30.	Ditto	Ditto
42	Punjab Department of Agriculture Leaflet No. 6 (Revised 1924) on Castor (*Ricinus communis*).	Ditto	Ditto
43	Season and Crop Report, Punjab, for 1923-24.	Ditto	Ditto
44	Tables of Agricultural Statistics for 1923-24 of the Punjab Department of Agriculture.	Ditto	Ditto
45	Sugar Industry in Western India and Methods of Sugar Manufacture. Bombay Department of Agriculture Bulletin No. 116. Price, Re. 1-2.	R. G. Padhye, B. Ag. (Bom.), M.S. (La, U.S.A.), Sugar Chemist and Technologist.	Yeravda Prison Press.
46	Investigations in Fig Culture and Treatment. Bombay Department of Agriculture Bulletin No. 117. Price, As. 5-6.	S. R. Gandhi, B. Ag., Demonstrator in Horticulture, Poona Agricultural College.	Ditto
47	Year Book of the Agricultural Department in the Southern Division, 1924. Bombay Department of Agriculture Bulletin No. 119. Price, As. 4-6.	Issued by the Department of Agriculture, Bombay.	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
48	Silage for Fodder in Western India. Bombay Department of Agriculture Bulletin No. 120. Price, As. 4.	E. J. Bruen, Live Stock Expert to the Government of Bombay, Poona.	Yeravda Prison Press.
49	Further Investigations on Potato cultivation in Western India. Bombay Department of Agriculture Bulletin No. 121. Price, As. 6.	Harold H. Mann, D.Sc., Director of Agriculture, Bombay Presidency, and W. V. Joshi, B. Ag.	Ditto
50	Experiments with the Automatic Water Finder in the Trap Region of Western India. Bombay Department of Agriculture Bulletin No. 72 of 1915. Revised (1925). Price, As. 4.	Harold H. Mann, D.Sc., Director of Agriculture, Bombay Presidency, and D. L. Sahasrabuddhe, M.Ag., M.Sc., Ag. Agricultural Chemist to the Government of Bombay.	Ditto
51	Annual Report of the Department of Agriculture in the Bombay Presidency for the year 1923-24.	Issued by the Department of Agriculture, Bombay.	Ditto
52	Season and Crop Report of the Bombay Presidency for 1923-24. Price, As. 7-6.	Ditto	Government Central Press, Bombay.
53	Sugarcane. Bombay Department of Agriculture Leaflet No. 6 (with Vernacular Versions).	Ditto	Yeravda Prison Press.
54	Top Dressing Cake Manure to the Rice Crop in Belgaum. Bombay Department of Agriculture Leaflet No. 7 (with Vernacular Versions).	Ditto	Ditto
55	Report on the Operations of the Department of Agriculture, Madras Presidency, for the official year 1923-24.	Issued by the Department of Agriculture, Madras.	Government Press, Madras.
56	Wood's Note Book of Agricultural Facts and Figures (Tamil Edition).	Translated by C. Narayana Ayyar, Assistant Director of Agriculture in charge of VIII Circle, Coimbatore.	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
57	Season and Crop Report of the Madras Presidency for 1923-24.	Issued by the Board of Revenue, Madras.	Government Press, Madras.
58	Hints to utilize sanded area in Trichinopoly and Tanjore Districts (Tamil). Madras Department of Agriculture Leaflet No. 40.	N. S. Kulandaswami Pillai, Assistant Director of Agriculture in charge of V Circle, Trichinopoly.	Ditto
59	Villager's Calendar for 1925-26. (Tamil, Telugu, Kanarese and Malayalam.)	Issued by the Department of Agriculture, Madras.	Ditto
60	Year Book of the Madras Department of Agriculture, 1924 (English).	Ditto	Ditto
61	Report on the working of the Department of Agriculture, Central Provinces, for 1923-24. Price, Re. 1.	F. J. Plymen, A.C.G.I., Director of Agriculture, Central Provinces.	Government Press, Nagpur.
62	Comments on the Return of Expenditure of the Provincial and District Gardens in the Central Provinces and Berar for the year ending the 30th June, 1924.	Ditto	Ditto
63	Season and Crop Report of the Central Provinces and Berar for 1923-24.	Issued by the Department of Land Records, Central Provinces.	Ditto
64	Report on the Agricultural Stations in the Southern Circle, Central Provinces, for 1923-24. Price, Re. 1.	J. C. McDougall, M.A., B.Sc., Deputy Director of Agriculture, Southern Circle.	Ditto
65	Report on the Demonstration work carried out in the Southern Circle, Central Provinces, for 1923-24. Price As. 8.	G. K. Kelkar and T. A. Chatpande.	Ditto
66	Report on the Cattle Breeding Operations in the Central Provinces and Berar for 1923-24. Price, As. 4.	S. T. D. Wallace, B.Sc., Deputy Director of Agriculture in charge Animal Husbandry.	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
67	Report on the Demonstration work carried out in the Northern Circle, Central Provinces, for 1923-24. Price, As. 8.	J. H. Ritchie, M.A., B.Sc., Deputy Director of Agriculture, Northern Circle, Jubbulpore.	Government Press, Nagpur.
68	Report on Agricultural Stations, Northern Circle, Central Provinces, for 1923-24.	Ditto	Ditto
69	Report on the Demonstration work carried out in the Western Circle, Central Provinces, for 1923-24. Price, As. 8.	S. G. Mutkekar, B.Ag., M.Sc., Deputy Director of Agriculture, Western Circle, Amraoti.	Ditto
70	Report on the Agricultural Stations in the Western Circle, Central Provinces, for 1923-24. Price, Re. 1-8.	Ditto	Ditto
71	Report on the Agricultural Stations in the Eastern Circle, Central Provinces, for 1923-24. Price, Rs. 1-8.	Rai Sahib Tundilal Powar, B.A., Deputy Director of Agriculture, Eastern Circle.	Ditto
72	Report on the Demonstration work carried out in the Eastern Circle, Central Provinces, for 1923-24. Price, As. 8.	Ditto	Ditto
73	Report on the Experimental Farm, Nagpur, Central Provinces, for the year 1923-24.	R. G. Allan, M.A., Principal, Agricultural College, Nagpur.	Ditto
74	Report on the Agricultural College, Chemical, Botanical and Mycological Research and Agricultural Engineer's Section, Maharaj Bagh Menagerie, 1923-24. Price, As. 8.	Issued by the Department of Agriculture, Central Provinces.	Ditto
75	Report of the Agricultural Department, Assam, for the year ending 31st March 1924.	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
76	Report of the Working of the Department of Agriculture, Assam, for the year 1924-25.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
77	Assam Department of Agriculture Leaflet on "Our Buffaloes and Cows and means of their Improvement" (in Assamese).	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
78	Agricultural Statistics of Burma for the year 1923-24. Price, Re. 1-8.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
79	Report on the Operations of the Department of Agriculture, Burma, for the year ended 30th June, 1924.	Ditto	Ditto
80	Season and Crop Report of Burma for 1923-24.	Issued by the Department of Settlements and Land Records, Burma.	Ditto
81	Report of the Mandalay Agricultural Station for the year ended 30th June, 1924.	Issued by the Department of Agriculture, Burma.	Ditto
82	Report of the Hmawbi Agricultural Station for the year ended 30th June, 1924.	Ditto	Ditto
83	Report of the Mahlaing Agricultural Station for the year ended 30th June, 1924.	Ditto	Ditto
84	Report of the Tatkon Agricultural Station for the year ended 30th June, 1924.	Ditto	Ditto
85	Report of the Akyab Agricultural Station for the year ended 30th June, 1924.	Ditto	Ditto
86	Report of the Hopin Agricultural Station for the year ended 30th June, 1924.	Ditto	Ditto
87	Report of the Padu Agricultural Station for the year ended 30th June, 1924.	Ditto	Ditto
88	Report of the Yawnghwe Agricultural Station for the year ended 30th June, 1924.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
89	Report of the Allanmyo Agricultural Station and Pwinbyu Seed Farm and Annual Reports of the Agricultural Chemist, Superintendent Stock Breeding, Economic Botanist, Mycologist, Entomologist and Sericultural work, Burma, for the year ended 30th June, 1924.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
90	Wheat Cultivation. Burma Department of Agriculture Cultivators' Leaflet No. 1.	Ditto	Ditto
91	The Storage of Cattle Manure. Burma Department of Agriculture Cultivators' Leaflet No. 3.	Ditto	Ditto
92	The Cultivation of Groundnut. Burma Department of Agriculture Cultivators' Leaflet No. 4.	Ditto	Ditto
93	Cultivation of Cabbage, Cauliflower, Knol-khol and Lettuce. Burma Department of Agriculture Cultivators' Leaflet No. 6.	Ditto	Ditto
94	Cultivation of Carrot, Raddish and Beet. Burma Department of Agriculture Cultivators' Leaflet No. 7.	Ditto	Ditto
95	Bean Cultivation. Burma Department of Agriculture Cultivators' Leaflet No. 8.	Ditto	Ditto
96	Tobacco Cultivation. Burma Department of Agriculture Cultivators' Leaflet No. 9.	Ditto	Ditto
97	Leguminous Crops cultivated for their Roots. Burma Department of Agriculture Cultivators' Leaflet No. 10.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
98	Cultivation of Cotton. Burma Department of Agriculture Cultivators' Leaflet No. 11.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
99	Cultivation of Jute. Burma Department of Agriculture Cultivators' Leaflet No. 12.	Ditto	Ditto
100	The Use of the Small Bullock Hoe (Tun-do). Burma Department of Agriculture Cultivators' Leaflet No. 13.	Ditto	Ditto
101	Coconut Cultivation in Arakan. Burma Department of Agriculture Cultivators' Leaflet No. 15.	Ditto	Ditto
102	Sunn-hemp Cultivation. Burma Department of Agriculture Cultivators' Leaflet No. 17.	Ditto	Ditto
103	The Seed Drill. Burma Department of Agriculture Cultivators' Leaflet No. 18.	Ditto	Ditto
104	Two Useful Rice-pounders used in the Shan States. Burma Cultivators' Leaflet No. 22.	Ditto	Ditto
105	Cultivation of Castor. Burma Department of Agriculture Cultivators' Leaflet No. 23.	Ditto	Ditto
106	Pebyugale. Burma Department of Agriculture Cultivators' Leaflet No. 30.	Ditto	Ditto
107	Dry weather cultivation of Burmese Vegetables on paddy soils. Burma Department of Agriculture Cultivators' Leaflet No. 31.	Ditto	Ditto
108	Note on Formation of Bamboo Plantations. Burma Department of Agriculture Cultivators' Leaflet No. 34.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
109	Sugarcane Cultivation. Burma Department of Agriculture Cultivators' Leaflet No 35.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
110	Guinea grass (*Panicum maximum*). Burma Department of Agriculture Cultivators' Leaflet No 44	Ditto	Ditto
111	Cambodia Cotton. Burma Department of Agriculture Cultivators' Leaflet No. 45.	Ditto	Ditto
112	The Cultivation of Onions. Burma Department of Agriculture Cultivators' Leaflet No. 46.	Ditto	Ditto
113	The Cultivation of Pe-Sinngoon or Pigeon Pea (*Cajanus indicus*). Burma Department of Agriculture Cultivators' Leaflet No. 47.	Ditto	Ditto
114	Instructions for the Culture and Manufacture of Tea. Burma Department of Agriculture Cultivators' Leaflet No. 49.	Ditto	Ditto
115	Instructions for the Culture and Manufacture of Coffee. Burma Department of Agriculture Cultivators' Leaflet No. 50.	Ditto	Ditto
116	The Manufacture of Jaggery. Burma Department of Agriculture Cultivators' Leaflet No. 51.	Ditto	Ditto
117	The new and improved type of Jaggery Furnace. Burma Department of Agriculture Cultivators' Leaflet No. 52.	Ditto	Ditto
118	Annual Report of the Agricultural Engineer, Mandalay, for the year ended 30th June 1924.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
119	Agricultural Calendar in Burmese for the year 1925-26.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
120	Report of the Agricultural Stations at Tarnab and Haripur in the North-West Frontier Province for the year ending 30th June, 1924.	Issued by the Department of Agriculture, North-West Frontier Province.	Government Press, Peshawar.
121	Report on the Season and Crops of the North-West Frontier Province for 1923-24.	Revenue Commissioner, North-West Frontier Province.	Ditto
122	Summary of Remarks on the Kharif Crops of the North-West Frontier Province for 1924.	Ditto	Ditto
123	Report on the Operations of the Department of Agriculture and Fisheries, Travancore, for 1923-24.	Issued by the Department of Agriculture and Fisheries, Travancore.	Government Press, Trivandrum.
124	Report on the Administration of the Village Panchayats and Department of Agriculture in the Cochin State for the year 1923-24.	Superintendent of Agriculture and Panchayats, Trichur.	Government Press, Cochin.
125	Annual Report of the Agricultural Department, Gwalior State, for 1923-24.	Issued by the Department of Agriculture, Gwalior.	Alijah Darbar Press, Lashkar.
126	Annual Report of the Agricultural Department, Mysore, for the year 1923-24.	Issued by the Department of Agriculture, Mysore.	Government Press, Bangalore.
127	Mysore Agricultural Calendar, 1925. Price, As. 2.	Issued by the Department of Agriculture, Bangalore.	Ditto
128	Annual Report of the Department of Agriculture, Baroda State, for the year 1922-23. Price, Rs. 1-8.	Issued by the Department of Agriculture, Baroda.	Baroda State Press, Baroda.
129	*Quarterly Journal of the Indian Tea Association.* Price, As. 6 per copy.	Issued by the Scientific Department of the Indian Tea Association, Calcutta.	Catholic Orphan Press, Calcutta.

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*concld.*		
130	The *Journal of the Madras Agricultural Students' Union* (Quarterly). Annual subscription Rs. 4.	Madras Agricultural Students' Union, Coimbatore.	The Electric Printing Works, Coimbatore.
131	*Indian Scientific Agriculturist* (Monthly). Annual subscription Rs. 4.	H. C. Sturgess, Editor; J. W. Mackay, Consulting Editor.	Calcutta Chromotype Company, Calcutta.
132	*Poona Agricultural College Magazine* (Quarterly). Annual subscription Rs. 2.	College Magazine Committee, Poona.	Arya Bhusan Press, Poona.
133	The *Planters' Chronicle* (Weekly). Price, As. 8 per copy.	United Planters' Association of South India, Coimbatore.	E. P. Works, Coimbatore.
134	*Journal of the Mysore Agricultural and Experimental Union* (Quarterly). Annual subscription Rs. 3.	Mysore Agricultural Experimental Union.	Bangalore Press, Bangalore.
135	*Rural Bengal* (Monthly)	N. N. Gupta, B.A., PH. D., B.Sc., Editor.	Russa Art Press, Bhawanipur, Calcutta.
136	*Krishak* (Bengali) (Monthly). Price, As. 5 per copy; Annual subscription Rs. 3-3.	U. C. Bannerji, Editor.	Sri Ram Press, 162, Bowbazar Street, Calcutta.
137	The *Old Boys Magazine, Agricultural College, Cawnpore* (Quarterly). Price per copy, As. 8; Annual subscription Rs. 2.	M. L. Saksena, L.AG., Editor.	Cawnpore Printing Press.
	AGRICULTURAL CHEMISTRY		
138	The Buffer action of some Burma Soils. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VII, No. 5. Price, As. 12 or 1*s*.	J. Charlton, M.Sc., A.I.C., Agricultural Chemist, Burma.	Messrs. Thacker, Spink & Co., Calcutta.

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	AGRICULTURAL CHEMISTRY—*concld.*		
139	Studies in the Chemistry of Sugarcane, II. Some Factors that determine the ripeness of Sugarcane. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VII, No. 6. Price, As. 8 or 9*d*.	B. Viswanath, F.I.C., Offg. Government Agricultural Chemist, and S. Kasinath Ayyar, B.A., Assistant to the Government Agricultural Chemist, Coimbatore.	Messrs. Thacker, Spink & Co., Calcutta.
140	The Phosphatic Nodules of Trichinopoly and the availability of Flour Phosphate as a Manure for Paddy. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VII, No. 7. Price, Re. 1-4 or 2*s*.	Rao Sahib M. R. Ramaswami Sivan, B.A., Dip. Agri., Government Lecturing Chemist, Agricultural College, Coimbatore.	Ditto
141	Report on the Soil Survey of the Saran District.	M. N. Ghosh, M.A., Offg. Agricultural Chemist, Sabour.	Government Press, Gulzarbag.
	BOTANY		
142	The Eradication of *Cyperus rotundus* L. A study in Pure and Applied Botany. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIII, No. 5. Price, Rs. 2-4 or 3*s*.	S. B. Ranade, B.A., M.Sc., and arranged and written by W. Burns, D.Sc. (Edin.), Economic Botanist, Bombay.	Messrs. Thacker, Spink & Co., Calcutta.
	MYCOLOGY		
143	The Mahali Disease of Coconuts in Malabar. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIII, No. 4. Price, As. 12 or 1*s*.	S. Sundararaman, M.A., Offg. Government Mycologist, Coimbatore, and T. S. Ramakrishnan, M.A., Assistant in Mycology, Coimbatore.	Messrs. Thacker, Spink & Co., Calcutta.
144	Studies in Diseases of the Jute Plant, (2) *Macrophoma Corchori* Saw. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIII, No. 6. Price, As. 8 or 9*d*.	F. J. F. Shaw, D.Sc., A.R.C.S., F.L.S., Offg. Imperial Economic Botanist, Pusa.	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	MYCOLOGY—*concld.*		
145	Red Rot Disease of Sugarcane. Burma Department of Agriculture Cultivators' Leaflet No. 5.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
146	The symptoms of "Ufra" Disease of Rice. Burma Department of Agriculture Cultivators' Leaflet No. 33.	Ditto	Ditto
147	Jowar Smut. Burma Department of Agriculture Cultivators' Leaflet No. 37.	Ditto	Ditto
148	Budrot of Palmyra Palm in Bengal (In English). Bengal Department of Agriculture Leaflet No. 2.	Issued by the Department of Agriculture, Bengal.	Bengal Government Press, Calcutta.
149	Budrot of Palmyra Palm in Bengal (In Bengali). Bengal Department of Agriculture Leaflet No. 3.	Ditto	Ditto
	ENTOMOLOGY		
150	List of Publications on Indian Entomology, 1923. Pusa Agricultural Research Institute Bulletin No. 155. Price, As. 11 or 1*s*.	Compiled by the Imperial Entomologist, Pusa.	Government of India, Central Publication Branch, Calcutta.
151	The Army Worm of Paddy. Madras Department of Agriculture Leaflet No. 38 (English, Tamil, Telugu, Kanarese and Malayalam).	Rao Sahib Y. Ramachandra Rao, M.A., Government Entomologist, Coimbatore.	Government Press, Madras.
152	Tobacco Aphis. Madras Department of Agriculture Leaflet No. 39.	Ditto	Ditto
153	Land Crabs as Agricultural Pests in Western India. Bombay Department of Agriculture Bulletin No. 118. Price, As. 8.	P. V. Wagle, B.Ag., Inspector of Agriculture on special duty, Tatta.	Yeravda Prison Press.

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	ENTOMOLOGY—*contd.*		
154	Instructions on Silkworm rearing. Burma Department of Agriculture Bulletin No. 21.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
155	Po-di-goung and Po-kyaing-gaung (Chafer Beetles and their grubs). Burma Department of Agriculture Cultivators' Leaflet No. 2.	Ditto	Ditto
156	The important Insect Pests of the Coconut in Burma and how to check them. Burma Department of Agriculture Cultivators' Leaflet No. 14.	Ditto	Ditto
157	The Red Cotton Bug (Wa Gon Po Ni). Burma Department of Agriculture Cultivators' Leaflet No. 16.	Ditto	Ditto
158	The Rice Hispa (Phalan-po or Po-laung-mi). Burma Department of Agriculture Cultivators' Leaflet No. 19.	Ditto	Ditto
159	Nga-Hmyaung-Doung (*Spodoptera mauritia*). Burma Department of Agriculture Cultivators' Leaflet No. 20.	Ditto	Ditto
160	The Lemon Butterfly. Burma Department of Agriculture Cultivators' Leaflet No. 21.	Ditto	Ditto
161	Crabs in Paddy Fields. Burma Department of Agriculture Cultivators' Leaflet No. 24.	Ditto	Ditto
162	The Common Hairy Caterpillars (Khu-gaung). Burma Department of Agriculture Cultivators' Leaflet No. 24.	Ditto	Ditto
163	Fruit Flies. Burma Department of Agriculture Cultivators' Leaflet No. 26.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	ENTOMOLOGY—*contd.*		
164	The Cotton Bollworms. Burma Department of Agriculture Cultivators' Leaflet No. 27.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
165	The Brown *Cerocceus Libisci* Green (Wa-Kaing-sant-Po-Wa). Burma Department of Agriculture Cultivators' Leaflet No. 28.	Ditto	Ditto
166	Field Crickets (Payit). Burma Department of Agriculture Cultivators' Leaflet No. 29.	Ditto	Ditto
167	Rats damaging Paddy. Burma Department of Agriculture Cultivators' Leaflet No. 36.	Ditto	Ditto
168	The Rice Case-worm (Ywet-hyatpo). Burma Department of Agriculture Cultivators' Leaflet No. 38.	Ditto	Ditto
169	The Army Worm (*Cirphis unipuncta*). Burma Department of Agriculture Cultivators' Leaflet No. 39.	Ditto	Ditto
170	The Paddy Grain Moth (*Sitotroga cerealella*). Burma Department of Agriculture Cultivators' Leaflet No. 40.	Ditto	Ditto
171	The Paddy ear-cutting Caterpillar (*Cirphis unipuncta*). Burma Department of Agriculture Cultivators' Leaflet No. 41.	Ditto	Ditto
172	The Paddy Stem Borers (Sit-po). Burma Department of Agriculture Cultivators' Leaflet No. 42.	Ditto	Ditto
173	Seed Storage and Prevention of Damage by Insects. Burma Department of Agriculture Cultivators' Leaflet No. 48.	Ditto	Ditto

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	ENTOMOLOGY—*concld.*		
174	Papers on Indian Tabanidae. Some Indian Species of Dipterous Genus *Atherigona*, Rondani. Memoirs of the Department of Agriculture in India, Entomological Series, Vol. VIII, Nos. 10 and 11. Price, Rs. 1-8 or 2*s*.	P. V. Isaac, B.A., D.I.C., M. Sc.. F.E.S., Second Entomologist (Dipterist), Pusa. (Vol. VIII, No. 10.) J. R. Malloch. (Vol. VIII, No. 11.)	Thacker, Spink & Co., Calcutta.
175	The *Nim* Mealy Scale (*Pulvinaria maxima*, Green). Memoirs of the Department of Agriculture in India, Entomological Series, Vol. VIII, No. 12. Price, Rs. 1-4 or 2*s*.	T. V. Ramakrishna Ayyar, B.A., F.E.S., Assistant Entomologist, Coimbatore.	Ditto
176	Catalogue of Indian Insects, Part 5. *Nitidulidae*. Price, As. 10.	S. N. Chatterji, F.E.S., Lower Grade Assistant, Entomological Branch, Forest Research Institute, Dehra Dun.	Government of India Central Publication Branch, Calcutta.
177	Catalogue of Indian Insects, Part 6—Staphylinidae. Price, Re. 1-14 or 3*s*. 3*d*.	Malcolm Cameron. M.B., R. N.., F.E.S., Lately Systematic Entomologist, Forest Research Institute, Dehra Dun.	Ditto
178	Catalogue of Indian Insects, Part 7—Lasiocampidae. Price, As. 10 or 1*s*.	T. Bainbrigge, Fletcher, R. N., F.L.S., F.E.S., F.Z.S., Imperial Entomologist, Pusa.	Ditto
179	Catalogue of Indian Insects, Part 8—Amatidae (Syntomidae). Price, As. 12 or 1*s*. 3*d*.	Ditto	Ditto
180	Catalogue of Indian Insects, Part 9—Zygaenidae. Price, Rs. 1-5 or 2*s*. 3*d*.	Ditto	Ditto
181	The Mango Hopper and how to control it. Punjab Department of Agriculture Leaflet No. 32.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
182	Short Note on the more important pests of main field crops and a few insecticides, Bengal Department of Agriculture Bulletin No. 4.	Issued by the Department of Agriculture, Bengal.	Bengal Government Press, Calcutta.

List of Agricultural Publications in India during 1924-25—contd.

No.	Title	Author	Where published
	BACTERIOLOGY		
183	Nitrogen Fixation in the Punjab. Memoirs of the Department of Agriculture in India, Bacteriological Series, Vol. II, No. 1 Price, As. 8 or 10*d*.	P. E. Lander, M.A., D. Sc., A.I.C., Agricultural Chemist, Punjab, and Barkat Ali, L.Ag.	Government of India, Central Publication Branch, Calcutta.
184	Preliminary Investigations in the Bacteriology of Milk. Pusa Agricultural Research Institute Bulletin No. 159. Price, As. 6 or 8*d*.	J. H. Walton, M.A., M. Sc., Assistant Bacteriologist, Pusa.	Ditto
	VETERINARY.		
185	Report of the Imperial Bacteriological Laboratory, Muktesar, for the two years ending 31st March, 1924. Price, Rs. 1-8 or 2*s*. 6*d*.	Director, Imperial Bacteriological Laboratory, Muktesar.	Ditto
186	Annual Report on the Punjab Veterinary College, Civil Veterinary Department, Punjab, and Government Cattle Farm, Hissar, for the year 1923-24. Price, Rs. 2-8.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
187	Annual Administration Report of the Civil Veterinary Department, Madras Presidency, for the year 1923-24.	Issued by the Civil Veterinary Department, Madras.	Government Press, Madras.
188	Annual Administrative Reports of the Bombay Veterinary College, Glanders and Farcy Department, and Civil Veterinary Department in the Bombay Presidency (including Sind) for the year 1923-24. Price, As. 5-6.	Issued by the Civil Veterinary Department, Bombay.	Government Central Press, Bombay.
189	Annual Report of the Bengal Veterinary College and Civil Veterinary Department, Bengal, 1923-24. Price, Re 1.	Issued by the Civil Veterinary Department, Bengal.	Bengal Government Press, Calcutta.
190	A note on treatment of Surra in Ponies by Tartar Emetic. Punjab Veterinary Bulletin No. 13 (reprinted in 1925).	Kahan Singh, G.P.V.C., P.V.S., Officer in charge of Camel Specialist's Office, Sohawa.	Government Printing, Punjab, Lahore.

List of Agricultural Publications in India during 1924-25—concld.

No.	Title	Author	Where published
	VETERINARY—*concld.*		
191	List of dates of Horse and Cattle Fair Shows to be held in the Punjab during 1924-25.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
192	A note on treatment of Surra in Donkeys by intravenous injections of Tartar Emetic.	Kahan Singh, G.P.V.C., P.V.S., Officer in charge of Camel Specialist's Office, Sohawa.	Ditto
193	Annual Report of the Camel Specialist for the year 1923-24. Price, As. 4.	Issued by the Department of Agriculture, Punjab.	Ditto
194	Annual Report of the Civil Veterinary Department, Bihar and Orissa, for the year 1923-24. Price, As. 12.	Issued by the Civil Veterinary Department, Bihar and Orissa.	Government Printing, Bihar and Orissa, Patna.
195	Annual Report of the Civil Veterinary Department, United Provinces, for the year ending 31st March 1924. Price, Re. 1-4-0.	Issued by the Civil Veterinary Department, United Provinces.	Government Press, United Provinces, Allahabad.
196	Report of the Civil Veterinary Department of the Central Provinces and Berar for the year 1923-24. Price, Re. 1.	Issued by the Civil Veterinary Department, Central Provinces and Berar.	Government Press, Central Provinces, Nagpur.
197	Report of the Civil Veterinary Department (including the Insein Veterinary School), Burma, for the year ending 31st March 1924. Price, Re. 1.	Issued by the Civil Veterinary Department, Burma.	Government Printing, Burma, Rangoon.
198	Anti-Rinderpest Serum. Burma Department of Agriculture Cultivators' Leaflet No. 32.	Issued by the Department of Agriculture, Burma.	Ditto
199	The Branding, Flaying and Curing of Hides. Burma Department of Agriculture Cultivators' Leaflet No. 43.	Ditto	Ditto
200	Report of the Civil Veterinary Department, Assam, for the year 1923-24. Price, As. 8 or 9*d*.	Issued by the Civil Veterinary Department, Assam.	Assam Secretariat Printing Office, Shillong.
201	Report of the Civil Veterinary Department, North-West Frontier Province, for the year 1923-24. Price, As. 12.	Issued by the Civil Veterinary Department, North-West Frontier Province.	North-West Frontier Province Government Press.

MGIPC—L—IV-2-83—31-3-26—850.

Review of Agricultural Operations in India 1925-26

BY

D. CLOUSTON, C.I.E., M.A., D.Sc.,
Agricultural Adviser to the Government of India

CALCUTTA: GOVERNMENT OF INDIA
CENTRAL PUBLICATION BRANCH
1927

Government of India Publications are obtainable from the Government of India Central Publication Branch, 3, Government Place, West, Calcutta, and from the following Agents :—

EUROPE.

OFFICE OF THE HIGH COMMISSIONER FOR INDIA,
42, GROSVENOR GARDENS, LONDON, S.W. 1.

And at all Booksellers.

INDIA AND CEYLON.

Provincial Book Depots :

MADRAS.—Office of the Superintendent, Government Press, Mount Road, Madras.
BOMBAY.—Superintendent, Government Book Depôt, Town Hall, Bombay.
SIND.—Library attached to the Office of the Commissioner in Sind, Karachi.
BENGAL :—Office of the Bengal Secretariat Book Depôt, Writers' Buildings, Room No. 1, Ground Floor, Calcutta.
UNITED PROVINCES OF AGRA AND OUDH :—Office of the Superintendent of Government Press, United Provinces of Agra and Oudh, Allahabad.
PUNJAB :—Office of the Superintendent, Government Printing, Punjab, Lahore.
BURMA :—Office of the Superintendent, Government Printing, Burma, Rangoon.
CENTRAL PROVINCES AND BERAR :—Office of the Central Provinces Secretariat, Nagpur.
ASSAM :—Office of the Superintendent, Assam Secretariat Press, Shillong.
BIHAR AND ORISSA :—Office of the Superintendent, Government Printing, Bihar and Orissa, P. O. Gulzarbagh, Patna.
COORG :—Office of the Chief Commissioner of Coorg, Bangalore.
NORTH-WEST FRONTIER PROVINCE :—Office of the Manager, Government Printing and Stationery, Peshawar.

Thacker Spink & Co., Calcutta and Simla.
W. Newman & Co., Ltd., Calcutta.
R. Cambray & Co., Calcutta.
S. K. Lahiri & Co., Calcutta.
The Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta and 226, Nawabpur, Dacca.
Butterworth & Co. (India), Ltd., Calcutta.
Rai M. C. Sarcar Bahadur & Sons, 90-2A, Harrison Road, Calcutta.
The Weldon Library, 17, Park Street, Calcutta.
Standard Literature Company, Limited, Calcutta.
Association Press, Calcutta.
Chukervertty, Chatterjee & Co., Ltd., 13, College Square, Calcutta.
The Book Company, Calcutta.
James Murray & Co., 12, Government Place, Calcutta. (For Meteorological Publications only.)
Roy Chowdhury & Co., 68-5, Ashutosh Mukherji Road, Calcutta.
The Oriental Publishing House, 34, Cornwallis Street, Calcutta.
B. C. Basak, Esq., Proprietor, Albert Library, Dacca.
Higginbothams, Madras.
V. Kalyanarama Iyer & Co., Madras.
P. R. Rama Iyer & Co., Madras.
Rochouse and Sons, Madras.
G.A. Nateson & Co., Publishers, George Town, Madras.
The Modern Stores, Salem, Madras.
Theosophical Publishing House, Adyar, Madras.
Bright & Co., Trivandrum.
The Booklovers' Resort, Taikad, Trivandrum, South India.
V. S. Swaminathan, Bookseller, West Tower Street, Madura.
E. M. Gopalakrishna Kone, Pudumandapam, Madura.
Vijapur & Co., Vizagapatam.
Thacker & Co., Ltd., Bombay.
D. B. Taraporevala Sons & Co., Bombay.
Sunder Pandurang, Bombay.
Ram Chandra Govind & Sons, Kalbadevi Road, Bombay.
N. M. Tripathi & Co., Booksellers, Princess Street, Kalbadevi Road, Bombay.
Proprietor, New Kitabkhana, Poona.
The Manager, Oriental Book Supplying Agency, 15, Shukrawar, Poona City.
R. S. Gondhalekar's Book Depôt, Publisher and Bookseller, Budhwar Chawk, Poona City.
Managing Director, Co-operative Bookstall, Booksellers and Publishers, Poona City.
Rama Krishna Bros., opposite Vishrambag, Poona City.
Karsandas Narandas & Sons, Surat.
Mangaldas & Sons, Booksellers and Publishers, Bhaga Talao, Surat.
Mrs. Radhabhai Atmaram Sagoon, Kalbadevi Road, Bombay.
A. H. Wheeler & Co., Allahabad, Calcutta and Bombay.
R. B. Umadikar & Co., The Bharat Book Depot, Dharwar.
The Standard Bookstall, Karachi, Quetta, Delhi, Murree and Rawalpindi.
The Karachi Book Depôt, Elphinstone Street, Camp, Karachi.
The Standard Bookstall, Quetta.
U. P. Malhotra & Co., Quetta.
J. Ray & Sons, 43, K. & L., Edwardes Road, Rawalpindi and Murree.
The Standard Book Depôt, Lahore, Lucknow, Nainital, Mussoorie, Dalhousie, Ambala Cantt. and Delhi.
N. B. Mathur, Supdt., Nazir Kanun Hind Press, Allahabad.
The North India Christian Tract and Book Society, 18, Clive Road, Allahabad.
Ram Dayal Agarwala, 184, Katra, Allahabad.
Manager, Newal Kishore Press, Lucknow.
The Upper India Publishing House, Ltd., 41, Aminabad Park, Lucknow.
Munshi Seeta Ram, Managing Proprietor, Indian Army Book Depôt, Juhi, Cawnpore.
Rai Sahib M. Gulab Singh & Sons, Mufid-i-Am Press, Lahore and Allahabad.
Rama Krishna & Sons, Booksellers, Anarkali, Lahore.
Puri Brothers Booksellers and Publishers, Katcheri Road, Lahore.
The Tilak School Bookshop, Lahore.
The Standard Bookstall, Lahore.
Manager of the Imperial Book Depôt, 63, Chandni Chawk Street, Delhi.
Oxford Book and Stationery Company, Delhi.
Supdt., American Baptist Mission Press, Rangoon.
Proprietor, Rangoon Times Press, Rangoon.
The Modern Publishing House, Ltd., 30, Phayre Street, Rangoon.
The International Buddhist Book Depôt, Post Box No. 971, Rangoon.
Burma Book Club, Ltd., Rangoon.
Manager, The "Hitavada" Nagpur.
Bhisey Brothers, Booksellers and Stationers, Sitabaldi, Nagpur.
S. C. Talukdar, Proprietor, Students & Co., Cooch Behar.
Times of Ceylon Co., Ltd., Colombo.
The Manager, Ceylon Observer, Colombo.
The Manager, The Indian Book Shop, Benares City.
The Srivilliputtur Co-operative Trading Union Ltd., Srivilliputtur (Satur S. I. R.).
Banwari Lal, Esq., Pakariya Street, Pilibhit, United Provinces.
The Manager, Educational Book Depôt, Jubbulpore.
Raghunath Prasad & Sons, Patna City.
Dandekar Brothers, Indore City.
The Hyderabad Book Depôt, Chaderghat, Hyderabad (Deccan).

TABLE OF CONTENTS

PAGE

CHAPTER I. AGRICULTURAL CONDITIONS OF THE YEAR . . . 1

CHAPTER II. ECONOMIC WORK ON CROPS—

I. Rice 3
II. Wheat 7
III. Cotton 10
IV. Sugarcane 25
V. Jute 32
VI. Other fibres 33
VII. Tobacco 34
VIII. Oil-seeds—
Linseed 36
Castor . . . . . *ib.*
Sesamum . . . . . *ib.*
Mustard . . . . . *ib.*
Groundnut 37
Coconut . . . . . *ib.*
IX. Tea 38
X. Coffee 39
XI. Rubber 40
XII. Fruit 41
XIII. Fodder crops and grasses 43
XIV. Juar (*Sorghum*) 46
XV. Ragi (*Eleusine coracana*) 47
XVI. Potatoes 48
XVII. Beans and pulses 49

CHAPTER III. RESEARCH AND INVESTIGATION—

I. Soils—
Survey of soils 50
Soil acidity 51
Soil moisture . . . . . *ib.*
Available phosphoric acid in soil . . . . *ib.*
Movements of nitrates 52
II. Nitrogen fixation . . . . . *ib.*

PAGE

III. Manures and fertilizers—
Organic manures 54
Nitrate of soda 56
Calcium cyanamide . . . . . *ib.*
Lime . . . . . *ib.*
Phosphates 57
Mineral requirements of different crops and varieties . *ib.*
Influence of manures on quality of crops . . . *ib.*
IV. Gur 58
V. Adulteration of ghee . . . . . *ib.*
VI. Milk . . . . . *ib.*
VII. Silage . . . . . *ib.*
VIII. Animal nutrition 59
IX. Lantana 60
X. Diseases of crops . . . . . *ib.*
XI. Insect pests 62
XII. Useful insects—
(1) Bees 63
(2) Lac . . . . . *ib.*
(3) Silkworms 64

CHAPTER IV. AGRICULTURAL ENGINEERING—
(1) Bombay 66
(2) United Provinces 67
(3) Punjab . . . . . *ib.*
(4) Bihar and Orissa . . . . . *ib.*
(5) Central Provinces . . . . . *ib.*
(6) Burma . . . . . *ib.*
(7) Madras 68
(8) Baroda . . . . . *ib.*
(9) Hyderabad . . . . . *ib.*
(10) Motor tractors . . . . . *ib.*

CHAPTER V. DISTRICT WORK—
(1) Bombay 70
(2) Madras . . . . . *ib.*
(3) Bengal 71
(4) Bihar and Orissa . . . . . *ib.*

PAGE

(5) United Provinces 72
(6) Punjab . . . . . *ib.*
(7) Central Provinces 73
(8) Burma . . . . . *ib.*
(9) Assam 74
(10) North-West Frontier Province . . . . . *ib.*
(11) Mysore . . . . . *ib.*
(12) Travancore . . . . . *ib.*
(13) Hyderabad . . . . . *ib.*
(14) Baroda . . . . . *ib.*
(15) Kashmir . . . . . *ib.*

CHAPTER VI. AGRICULTURAL EDUCATION—

I. Agricultural Colleges—

(1) Poona 75
(2) Coimbatore 76
(3) Lyallpur . . . . . *ib.*
(4) Cawnpore . . . . . *ib.*
(5) Nagpur . . . . . *ib.*
(6) Mandalay 77
(7) Pusa . . . . . *ib.*
(8) Bangalore . . . . . *ib.*

II. Agricultural schools 78
III. Short courses 81

CHAPTER VII. THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE—

(1) Bombay 84
(2) Madras . . . . . *ib.*
(3) Bengal 85
(4) Bihar and Orissa . . . . . *ib.*
(5) United Provinces . . . . . *ib.*
(6) Punjab 86
(7) Central Provinces . . . . . *ib.*
(8) Burma 87
(9) Assam . . . . . *ib.*
(10) Delhi . . . . . *ib.*
Co-operative cotton sale societies . . . . . *ib.*

PAGE

Co-operative milk societies 88
Cattle insurance . . . . . *ib.*

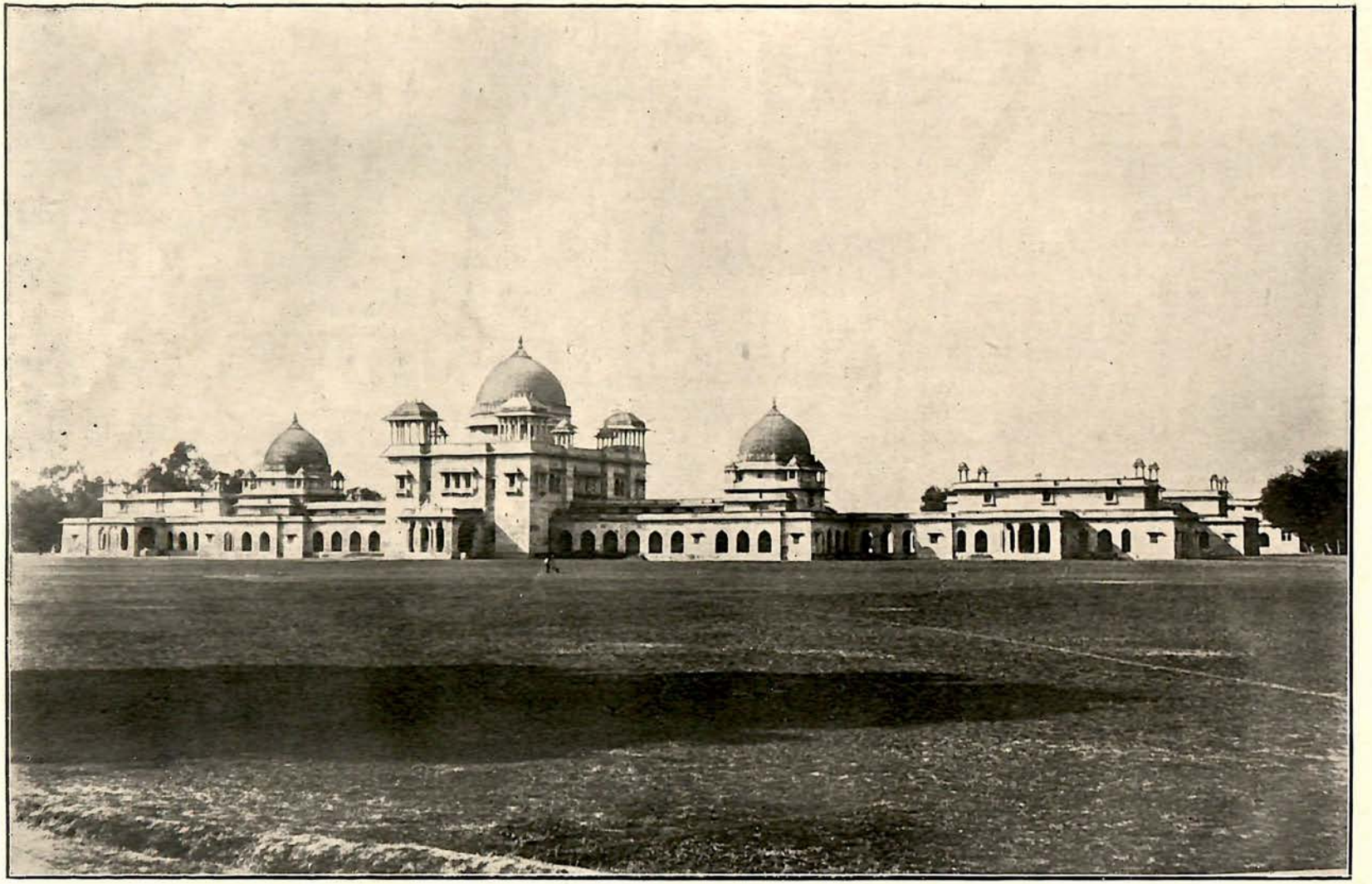
CHAPTER VIII. LIVE STOCK—
I. Prevention and treatment of disease 89
II. Incidence of disease 90
III. Preventive inoculation 91
IV. Veterinary education 93
V. Veterinary research 94
VI. Breeding—
(1) Cattle-breeding 96
(2) Sheep-breeding 101
(3) Poultry-breeding 102

CHAPTER IX. PUBLICATIONS OF THE AGRICULTURAL DEPARTMENTS—
(1) Imperial 104
(2) Provincial . . . . . *ib.*

CHAPTER X. RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL DEPARTMENTS 106

APPENDIX I. AREAS UNDER NEW AND IMPROVED VARIETIES OF CROPS DURING THE YEAR 1925-26 . . . 109
" II. LIST OF AGRICULTURAL STATIONS IN BRITISH INDIA IN 1925-26 113
" III. QUANTITIES OF MANURES EXPORTED, IMPORTED AND PRODUCED IN INDIA DURING LAST FIVE YEARS . 121
" IV. TABLE SHOWING RESULTS OF WELL-BORING DURING 1925-26 123
" V. TABLE SHOWING THE NUMBER OF IMPROVED IMPLEMENTS SOLD THROUGH DEPARTMENTAL AGENCY DURING 1925-26 124
" VI. LIST OF AGRICULTURAL COLLEGES AND SCHOOLS IN BRITISH INDIA IN 1925-26 125
" VII. OPERATIONS OF NON-CREDIT AGRICULTURAL CO-OPERATIVE SOCIETIES IN BRITISH INDIA DURING 1925-26 128
" VIII. TABLE SHOWING THE WORKING OF THE PROVINCIAL CIVIL VETERINARY DEPARTMENTS DURING 1925-26 132

		PAGE
APPENDIX	IX. TABLE SHOWING DETAILS AS TO STUDENTS OF VETERINARY COLLEGES AND SCHOOLS IN INDIA DURING 1925-26	133
„	X. TABLE SHOWING THE NUMBER OF CATTLE ISSUED FROM GOVERNMENT FARMS DURING 1925-26 .	134
„	XI. LIST OF AGRICULTURAL PUBLICATIONS IN INDIA DURING 1925-26	135



THE CAWNPORE AGRICULTURAL COLLEGE.

Review of Agricultural Operations in India 1925-26

CHAPTER I.

AGRICULTURAL CONDITIONS OF THE YEAR.

The Arabian Sea monsoon of 1925 made an early start and heavy precipitations were recorded in June over large tracts of the country. The late rains were, however, deficient, especially in Gujarat and Berar where the total rainfall was below the normal by 32 and 21 per cent. respectively. In North-East India, Orissa suffered from floods, Western Bengal and Chota Nagpur from a prolonged drought, while the late arrival of the monsoon in Bihar generally prejudiced the autumn crops. Untimely and heavy rainfalls in March and April accompanied by hail caused much damage to standing as well as harvested winter crops in Upper India. The season, though characterized by uneven distribution of rainfall, can, taking India as a whole, be described as fair, almost all the important crops giving moderately good outturns.

The general condition of the agricultural population, depending as it does primarily on the course of the monsoon, was fairly good. The year saw a drop in the selling values of cotton and *gur*, but the cultivators were to some extent recompensed by the cheaper prices prevailing for imported cloth. There was no lack of employment for agricultural labourers who were able to command good wages.

The cattle population was not so fortunate. There was by no means any abnormal fodder shortage, but rinderpest raged throughout the greater part of the year and mortality reached a record figure.

CHAPTER II.

ECONOMIC WORK ON CROPS.

Notwithstanding the paramount importance of crops in Indian agriculture, the average cultivator rarely devotes much attention to the seed he sows. Good types exist, but, by neglect and lack of appreciation of the importance of seed selection as a means of increasing production, they have, accidentally and by natural cross-fertilization, become hopelessly mixed. The mixtures grown are of the low yielders with little power to respond successfully to improved methods of cultivation or to the application of manure. Among all the methods of making the fields of India more productive, the supply of pure seed of the various crops grown has, therefore, been placed in the forefront. The separation of the mixtures into their component parts and the testing of the economic value of the types found therein has proved a very fruitful piece of work, and several high-yielding strains suitable for different soil and climatic conditions have been brought into general cultivation. When difficulty in getting suitable types by pure line selection has been experienced, hybridization has been resorted to, and we have now entirely new strains of wheat, cotton and sugarcane under cultivation.

The progress made in introducing the new varieties has been rapid and the monetary gain resulting therefrom considerable. The extent to which the Indian ryot has responded to the lure of increased returns will be made manifest by a perusal of Appendix I (p. 109). The figures given below do not do full justice to the crop improvement work of the Agricultural Department, for the selected varieties in the case of certain crops such as wheat and cotton have come into such general use that departmental statistics no longer represent their full spread.

Crop	Area in acres under improved varieties
Cotton	3,198,504
Wheat	2,342,001
Rice	654,332
Jute	336,485
Sugarcane	171,808
Other crops	709,727
TOTAL	7,412,857

An increase of 100 per cent. and over in the net profits has taken place in some cases where either an improved variety of the same crop or a quite new crop has been introduced. The Director of Agriculture, United Provinces, writes: "In the whole province there are this year not less than 100,000 acres of improved canes. The extra profit from this one improvement this year will be somewhere near a crore of rupees." In Bihar, Dahia paddy has almost doubled the yield of poor rice land, while a crop of groundnuts worth Rs. 1,00,000 is now harvested from land which formerly produced other crops valued at not more than Rs. 16,000. Similarly, in Bombay, an improved variety of groundnut has doubled the income previously obtained from less profitable crops on over 364,000 acres. The cultivation of gram, which is grown in rotation with wheat in heavy black clay loams of Burma, was in danger of being entirely given up on account of the ravages of *Fusarium* wilt, but the presence of a wilt-free variety known as Karachi gram on the padu farm saved the situation. During the last four years the area under the Karachi variety has increased from 400 acres to 60,000 acres which is 50 per cent. of the total acreage under the crop. Assuming that the additional profit obtained from the adoption of all departmental varieties is on an average only Rs. 10 per acre, it is estimated that the annual value of the agricultural crops of the country has been enhanced by nearly 7½ crores of rupees. But even this large additional profit is capable of being almost doubled on the same area, by improving the cultural practices followed by the general mass of agriculturists. To take only one instance, while the average yield per acre of the American 4F. cotton on the Khanewal estate of the British Cotton Growing Corporation is nearly 10 cwt., in the fields of the zemindars it is not more than 5 cwt.

I. Rice.

Occupying on an average 35 per cent. of the total cultivated area, rice is pre-eminently the most important crop in India. Nearly 91 per cent. of the produce of this huge area is consumed locally in a normal year; the remaining 9 per cent. is exported abroad mainly from Burma. The export trade during the year under review was valued at Rs. 39,97 lakhs. Being mainly a monsoon crop, both its area and yield are largely affected by the amount

and distribution of the rainfall. The total acreage of 82,078,000 under rice in the year under report showed an increase of 637,000 acres, but on account of poor yields in Bihar and Orissa and Burma, the total outturn (30,572,000 tons) was estimated to be less by 2 per cent. than that of the previous year and of the average for the preceding quinquennium.

In BENGAL, rice occupies over 81 million acres or 71 per cent. of the cropped area of the province and 25 per cent. of the total acreage under the crop in India. Rice investigations therefore figure prominently in the programme of the plant-breeders of the province, who have succeeded in isolating types which give larger yields when grown under conditions to which they are suited. They are the transplanted *amans* Indrasail and Dudshar suitable for heavy and light soils, respectively, in Northern and Eastern Bengal, and the broadcast *aus* Kataktara which is unrivalled as a yielder when grown on fertile high land in rotation with a *rabi* crop. During the year under report, these are estimated to have been sown in an area of 133,270 acres.

These types, however, do not suit the different conditions obtaining in West Bengal where an early maturing *aus* is required. Both intra-varietal selection and hybridization are being employed to obtain the desired variety, and a measure of success has already been achieved. Some of the *aus* crosses when subjected to yield tests during the year, while equal in yielding capacity to Kataktara, ripened a fortnight earlier. If these results are confirmed in field-scale trials, the new strains will be invaluable on double-cropped land where, in order to give a sufficient period of growth to the succeeding *aman* rice, the *aus* crop must be harvested in good time. A heavy-yielding type of the fine Balam rice, which seems to thrive well particularly round the coast line of the Bay of Bengal, has also been isolated.

That manuring with phosphates lowers the transpiration rate of rice has been confirmed by observations made on a large scale in the field. It would, therefore, appear that in years of deficient rainfall phosphates are particularly helpful in maturing a crop which would otherwise suffer from shortage of moisture.

Indrasail and Dudshar are ready for harvesting about 55 days after flowering; seeds of full germinating capacity have, however,

been harvested even after 23-27 days. In the case of Kataktara the period of maturity was previously found to be 20 days. This indicates that the cultivator could, if he so desired it, harvest the paddy intended for seed before that intended for food, and thereby extend the period of the rice harvest.

In MADRAS, where, like Bengal, rice is the main cereal crop, a special officer has been appointed for paddy breeding. He is in charge of the paddy station at Coimbatore and of three sub-stations in the principal rice-growing tracts. G. E. B. 24 and CO. 1, 2 and 3 are being distributed from Coimbatore and A. 1-7 from Aduturai. Of these, G. E. B. 24 holds pride of place as regards popularity and yield. It combines earliness with fine quality, gives nearly 5,000 lb. of grain per acre and can be grown successfully under varying conditions. Two more strains have since been established at Coimbatore which have for the last 3 years consistently given an increase, over the check plot, of 12 per cent. These will be tested in the districts before the distribution of the seed is taken up.

Progress has been made with a study of the genetic behaviour of the various factors which contribute towards yield, disease resistance, good stand, well-filled grains, etc.; pigmentation appears to be closely related to the more complex factors of duration, size of grain, etc.

As BURMA contributes three-fourths of the rice exported from this country, the selection of varieties is made on the basis of their yields and cultural advantages, their behaviour in the mills and the requirements of the foreign market. The improved varieties now grown on nearly two lakhs of acres have, therefore, won the esteem of both growers and millers and obtain a premium of Rs. 8 to Rs. 15 per unit of 100 baskets. To quote from the speech of the Chairman at the annual meeting of the Rangoon Chamber of Commerce, "Any one connected with the paddy trade now knows that the cultivator expects and gets a special premium for these special grains, and that it is well worth the extra cost the miller pays, the miller knows."

A type of Ngayunwa promises to replace at Mandalay the older selections T. Ngasein and T. Taungdeikpan in the irrigated tracts of Upper Burma. High-yielding strains have also been isolated

from the deep-rooted and drought-resistant Ngathalun which are eminently suitable for stiff soils. At Hmawbi, the work is planned with a view to the isolation of slightly earlier types of rain-fed paddies than the now widely cultivated Ngasein 8, and hundreds of pure local strains, exotics and hybrids are under observation. Ngasein C. 19-26 given out last year for large-scale trials has been found quite suited to the Mon irrigation tract.

The pre-eminence of Sabour Dahia on poor land, liable to drought, remains unchallenged in BIHAR AND ORISSA. Originally selected for South Bhagalpur, it has made headway wherever introduced in the province. The co-operative banks are interesting themselves in its spread. Selections made from Kakharua at Cuttack have become popular in parts of Orissa.

The advantages of applying phosphates to rice land are now well understood in South Bhagalpur, and large consignments of superphosphate are obtained by co-operative banks. Experiments are being made at Banka and Jamui to determine the relative values of the different phosphatic manures on the market.

The rices selected in ASSAM for their high yielding capacity are the *sail* varieties Georgesail, Latisail and Indrasail; the *aus* Murali $\frac{86}{30}$ and Basmati, and the *asra* Birpak. On cultivators' fields they yielded up to 360 lb. more than the local varieties of their kind. Definite increases of outturn have been obtained up to 270 lb. by manuring with bonemeal.

In C. 13·4 and Bh. 13 the CENTRAL PROVINCES has got late and medium rices suitable for the Eastern Circle, which are reported to yield about 450 lb. more per acre than the local mixture. The early varieties are not so well represented, but some promising types are under trial. The early type No. 13 isolated on the Adhartal farm in the Northern Circle, where the critical period of the monsoon is the end of August, has been well received in Damoh and Katni. Selection work on medium paddies has given a strain (No. 6) which will probably oust the old favourite No. 17.

Rice-breeding work at Karjat, Ratnagiri, Mugad and Larkana in the BOMBAY Presidency has yielded pure strains which give an increased outturn of 20—35 per cent. over the local mixtures. In addition to Kolamba 42, which has already become popular in the North Konkan, the Karjat station has produced another strain

named Kolamba 79 which is particularly suitable for the South Konkan. The work at Ratnagiri and Mugad is still in its initial stage; the types isolated at the former station, however, combine good yield with marked resistance to the rice borer.

Valuable results regarding the best way of increasing the yield of rice by manuring have been obtained at Karjat. Sulphate of ammonia has proved a satisfactory substitute for *rab* treatment when applied to the seed-beds. As a fertilizer it has given a good account of itself when applied to the crop at a later stage. In the Kanara rice soils bonemeal is more economical than ammonium sulphate.

A special rice-breeding farm has been opened during the year at Kala Shah Kaku in the PUNJAB, where 347 samples of rice have been collected from all over the province and sown in the nursery for pure line selection.

Early maturing varieties of rice such as Banku and Halubbalu are under distribution in the semi-malnad tracts of the MYSORE State. A variety recently introduced from Coimbatore promises to adapt itself to the pure malnad area.

In the TRAVANCORE State, work was mainly directed towards the study of various varieties imported from Aduturai and the effect of different manures on the yield of rice.

Preliminary trials with the Karjat selections of Kolamba rice have given encouraging results in the Navasari District of the BARODA State.

II. Wheat.

Wheat is the main food-staple of the people of Upper India. The acreage is second only to that of rice, and is on an average 10 per cent. of the total cultivated land of the country. The area of 30,470,000 acres sown during the year was less than that of the previous year by 4 per cent., but with an increase of 15 lb. in the yield per acre, the total outturn of 8,704,000 tons represented a reduction of only 2 per cent. India normally produces a surplus of wheat which is either exported abroad or carried over in stock for consumption in bad seasons; a shortage of 6 per cent. in output from the average of the preceding five years, the depletion of old stocks by heavy shipments in 1924-25 and a poor demand from abroad all

combined to reduce the exports by 81 per cent. in quantity and 79 per cent. in value.

One of the greatest successes of the Agricultural Department in India is the isolation of heavy-yielding, rust-resistant wheats of good milling and baking qualities, similar in class to Manitoba wheats and suitable both for home consumption and export. The value of these wheats has been recognized by the cultivator; the area under them now exceeds two million acres. There are no better known Indian varieties of any crop either in this country or abroad than Pusa 4 and Pusa 12. They are to be found in every wheat tract in India. Their fame is spreading to other lands too; during the year there was a demand for seed from Australia, South Africa, Kenya, Egypt, Iraq, Algeria and Japan.

In more recent years a new type called Pusa 52 has been fixed by hybridization, which being an awned wheat is not so open to attack by birds as the older selections. In large-scale tests, both on Government farms and private estates, in Bihar the United Provinces and the Central Provinces, this bearded hybrid has fulfilled the promise of heavy yields held out during the preliminary trials of last year. It has been adopted for seed distribution by the Department of Agriculture in Bihar and Orissa. Another promising new variety is Pusa 80-5 which has given yields up to 22·3 cwt. per acre. Extensive trials with this wheat are projected with a view to deciding its ultimate worth.

With over 34 per cent. of the total acreage under the crop in the whole of India, the PUNJAB is the premier wheat-growing province. The varieties distributed by the department are Punjab 11 and Punjab 8A; the latter gives a higher yield of both grain and *bhusa* on irrigated as well as rain-fed lands, and is gradually replacing the former. The area under Punjab 8A is reported to have increased by 576,500 acres and that under Punjab 11 to have decreased by 264,500 acres as compared with the previous year. Pusa 4 has been found specially suitable for water-logged areas in the Gurdaspur Circle, while Pusa 12 is popular in tracts where wheat is irrigated from wells. The area of 1,156,946 acres cropped with these improved varieties is over 12 per cent. of the wheat acreage of the province, and the extra profits earned by the cultivators are estimated at Rs. 1,73 lakhs.

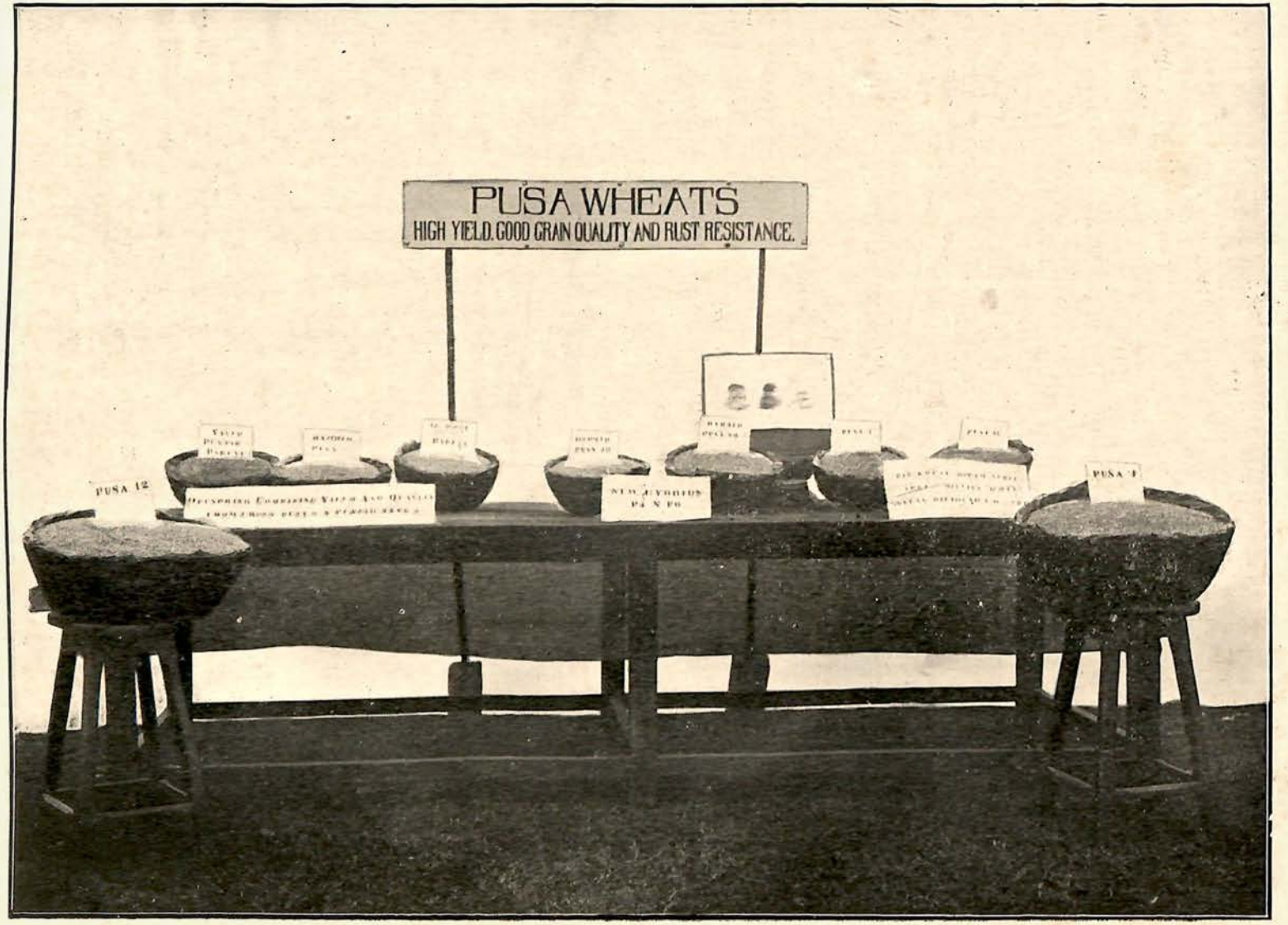

PUSA WHEATS
HIGH YIELD, GOOD GRAIN QUALITY AND RUST RESISTANCE.
PUSA 12
PUSA 4

PLATE II.

An experiment designed to determine the effect of varying numbers of irrigations indicates that with one irrigation the yield is considerably less on account of the presence of a large number of shrivelled grains, while with irrigations exceeding three the quality of the produce suffers from the presence of a high proportion of mottled grains.

Nowhere in India have Pusa 12 and Pusa 4 received such wide recognition as in the UNITED PROVINCES which is the second largest wheat-growing tract in India. Together with Cawnpore 13, for which there is only a very limited demand, they occupied during the year 844,138 acres, or nearly 12 per cent. of the provincial wheat area. The stores established to meet the insistent demand for wheat seed number 127—an increase of 29 during the year. These depôts conducted on strictly commercial principles made a profit of 29 per cent. on an investment of Rs. 1,60,162. No that the ryot is willing to pay a premium for the seed which he has come to value, private enterprise should, as in other countries, be induced to come forward as seed merchants.

None of the new varieties introduced on the Tarnab farm in the NORTH-WEST FRONTIER PROVINCE has ever equalled Pusa 4 in standing power, freedom from rust, or quality of grain. As the latter also ripens ten days earlier than any other variety grown in the province, it appeals to the Frontier Pathan. In the year under report it was sown on over two lakhs of acres. In varietal tests carried out at altitudes of from 2,000 to 6,000 feet in the Kurram Valley, Pusa 4 won easily.

Pusa 4 having proved a heavy yielder on all the demonstration plots laid down by six co-operative societies in North BIHAR, its seed is in demand. Similar results with Pusa 12 in South Bihar have induced the Co-operative Department to start three centres with a view to supplying seed to individual members of societies in that tract.

Yield tests running over a period of three years have shown conclusively at Padu in BURMA that Sagaing 102 is outstandingly better under local conditions than any Indian variety. In the Shan States, Federation and Pusa 4 continue to maintain their superiority over the local wheats in black and red soils respectively. Both were, however, affected by rust during the year, and Pusa

52 is being given a trial to determine whether it is more resistant.

Pusa 100 is the favourite wheat in irrigated tracts of the Southern and Eastern Circles of the CENTRAL PROVINCES. At Labhandi it has over a period of nine years given on an average 69 per cent. more grain than the local Kathia. The new hybrids A. 113 and A. 115 are replacing A0 13 in the Northern Circle. A. 115 has acquired the trade name of Sharbati and secures a premium of annas 12 per maund in the market. A0 68, A0 13 and A0 49 are the varieties recommended for the plateau districts. The total area under these higher yielding strains is estimated to be 125, 138 acres.

The superiority of Pusa 12 over *desi* wheats on the rain-fed areas of Upper SIND has now been established. Pusa 4 is making rapid progress in North Gujarat and in the contiguous districts of the Baroda State where it has proved a higher yielder than the local Wajia.

III. Cotton.

During the year under review, the area under cotton rose to 28,101,000 acres as compared with 26,801,000 acres during 1924-25, the estimated yield being 6,075,000 bales—a decrease of 13,000 bales. The average yield per acre was 86 lb. of ginned cotton as compared with 91 lb. and 87 lb. in the two preceding years. The quantity of raw cotton exported during the year ending 31st March, 1926, was 4,173,400 bales of 400 lb. as compared with 3,326,400 bales in the previous year. The value of cotton goods exported was Rs. 9,65 lakhs.

The final figure of the American crop of 1925 was 16,103,679 bales of 500 lb., the final estimate of the area planted having been 48,090,000 acres, as against the first estimate of 46,448,000 acres. Since the crop of 1914, when 16,135,000 bales were produced, this was the first time a crop of more than 14 million bales had been produced. For the 1926 crop the first estimate of area was 48,898,000 acres, as compared with 46,448,000 acres for the previous year; the yield is estimated to be about 18½ million bales excluding linters. The latest American estimate of yield per acre is 187 lb. of ginned cotton, as compared with 209·2 lb. per acre for the 16 million bale crop of 1914-15 which was produced from 37 million acres.

Consequent on the fall in price of American cotton, the Bombay price of Broach cotton fell from Rs. 473 per candy on 3rd April, 1925, to Rs. 350 on 25th March, 1926. The stock of cotton held in Bombay on 31st August, 1926, was 427,000 bales, as compared with 373,000 bales on the same date in the previous year—an increase of 54,000 bales. The fall in price does not, however, seem to have caused any serious decline in the sowings in India in 1926, as the area recorded in the third forecast is 24 million acres, as against 26½ million acres in 1925.

The INDIAN CENTRAL COTTON COMMITTEE has now completed its fifth year since its constitution as an advisory body and its third year since its incorporation under the Indian Cotton Cess Act, 1923. The Committee has continued to devote attention to the improvement of cotton marketing, the prevention of malpractices and to the general interests of the cotton industry, and each year is doing more to provide for and to promote research for the improvement of cotton growing. Perhaps the most important features of the year's work have been the details connected with the administration of the Cotton Ginning and Pressing Factories Act, 1925, the extension of the Cotton Transport Act to new areas, the Committee's enquiry into the finance of the cotton crop up-country and into the organization of primary cotton markets, and further progress in cotton research.

The Cotton Ginning and Pressing Factories Act has been in force since 1st September, 1925—the beginning of the cotton season 1925-26. The practical administration of the Act depends largely on rules framed under the Act by the Government of India and by Provincial Governments, and much of the time of the Committee has been taken up in considering and advising on details of such rules. From 1st September, 1926, baled cotton not marked in accordance with the provisions of the Act can be refused by any purchaser, and is not tenderable in Bombay in fulfilment of either a hedge or delivery contract. Several instances have already been received which illustrate the practical value of the Act in dealing with abuses. A large majority of those Indian States which produce cotton in considerable quantity have already either passed similar legislation or have announced their intention of doing so. The weekly statistical returns of cotton pressed, which the Act

makes compulsory, have already proved to be of great value and their importance will increase. In this connection it may be observed that the Government of India have sanctioned again the recording of statistics for the internal railborne trade in cotton, so that officers responsible for the preparation of provincial cotton forecasts have now at their disposal considerably improved means of checking the direct estimates of production and of periodically revising the figures for the "normal" yield per acre which form the basis of the crop forecasts. In all provinces the necessary rules providing for a better standard of construction of new ginning factories, for the paving of press houses and for the use of proper weights and measures in all ginning and pressing factories are now in force.

The Cotton Transport Act has continued to be of great value in the three zones in Gujarat and the three zones in the south of the Bombay Presidency to which the Act has been applied. All trade reports go to show that the application of the Act has led to very real improvement in the purity and quality of Surat, Kumpta and Dharwar cottons. As very substantial progress has been made with the establishment of a single improved variety (Surat 1027) in that part of Gujarat south of the river Narbada, the Government of Bombay have now withdrawn the restrictions on the transport of *kapas* by road between the three Surat zones, maintaining, however, the restrictions on the transport by rail for the present.

The Central Cotton Committee has advised on a proposal to apply the Cotton Transport Act to the Broach cotton area, north of the river Narbada, with a view to protecting the Broach cotton crop from the introduction of inferior cotton from the north and east. It is proposed that the restrictions, for the present at any rate, should be confined to transport by rail. The successful working of the Cotton Transport Act in Gujarat is due in no small measure to the hearty co-operation of the Baroda and Rajpipla Durbars which have introduced similar laws; without such co-operation the administration of the Act would be difficult as State and British territories are much intermingled.

The Cotton Transport Act has been put into force in Madras in the Northerns and Westerns, Cambodia and Tinnevelly zones. The boundaries of these zones as fixed by the Legislative Council

are not entirely in accord with the original recommendations of the Central and Provincial Cotton Committees, the second zone in particular having been considerably enlarged as a result of representations to the effect that the position of a number of cotton growers would otherwise be adversely affected. Some modification of the present boundaries will doubtless be found necessary, and it is understood that the position will be reviewed shortly in the light of the experience gained from the first year's working.

The Committee's enquiry into the finance of the cotton crop up-country has been considerably extended and developed during the year. It was quickly ascertained that the necessary facts could not be obtained through the medium of a general questionnaire, and local detailed investigations in selected areas were consequently decided on. Such investigations have been carried out in parts of Khandesh, Berar, Upper Gujarat and the Madras Northerns and Westerns cotton areas, the staff being appointed by the Agricultural Departments concerned but, except in Madras, paid for by means of grants from the Central Cotton Committee. In the villages selected for investigation details have been obtained from each cotton grower of the area sown with cotton, yield, approximate dates for picking and marketing, methods of marketing, prices realized, deductions and expenses paid by the grower, the dates and amounts of loans and the rates of interest paid. General information as to market difficulties was also obtained from the growers. A number of cotton markets was visited, and arrivals, prices, deductions, allowances and market charges recorded, together with general information regarding the management and customs of the market. The results are now being compiled and examined and will be published shortly. Similar investigations will probably be undertaken in other cotton-growing tracts. The labour involved in such investigations is very considerable and the cost by no means negligible; but this appears to be the only method by which an answer can be obtained to the questions as to how far the cultivator is hampered in his efforts to obtain full value for his produce by lack of financial facilities, and to what extent his difficulties are mainly due to lack of suitable market organization.

The Committee received a series of complaints as to the unsatisfactory quality of Sind and Sind-Punjab short-stapled cottons which pointed to faulty ginning, if not to deliberate malpractices in gins and presses, and the Committee undertook, at the request of the Karachi Indian Merchants' Association, *an examination of cotton marketing conditions* in Karachi. It was represented that the unsatisfactory quality of Sind and Sind-Punjab cottons is due, at least in part, to faulty market organization, and that the Karachi cotton market had not kept pace with the growth of trade and of exports from that port. The question is still under consideration but, as a result of the discussion which took place, a joint meeting of all sections of the cotton trade was called by the Karachi Chamber of Commerce in August, and improved market rules, including provision for standards and for arbitrations, were mutually agreed to and came into effect from 1st January, 1927. The question as to what further steps, if any, are required is still under consideration. The policy of the Central Cotton Committee in such cases is not to interfere in matters of local detail but to render every assistance to local organizations in improving existing conditions.

No further progress has been made with the *organization of primary cotton markets* in the various provinces. The Government of Bombay have in preparation a bill for the establishment of open cotton markets in that presidency, and it is understood that the Government of the Central Provinces and Berar have under consideration the improvement of the rules governing open cotton markets in that province. The Punjab Provincial Cotton Committee has devoted considerable attention to the possibilities of open cotton markets in that province; the matter is still under consideration, but the indications are that what is needed is better provision for general markets for all staple agricultural products, with special rules for cotton trading.

Marketing of improved cottons. A further series of spinning trials on Indian staple cottons was organized by the Empire Cotton Growing Corporation in co-operation with the Oldham Master Cotton Spinners' Association, and these have confirmed the previous conclusion that a number of Indian cottons are now capable of replacing American cotton for many purposes. Type bales of

the more important of such cottons, *viz.*, those which have reached a commercial scale, have been supplied to the Liverpool, Manchester and East India Cotton Associations in order that spinners and merchants can obtain reliable samples, named under the Agricultural Department's varietal descriptions, for comparison with commercial types of Indian cottons offered by various shippers. The above Cotton Exchanges have again promised their co-operation during the coming year.

Another important innovation has been the introduction of the Liverpool Empire and Miscellaneous futures contract against which Indian cottons equal to Strict Low Middling American in staple, grade and value are tenderable in common with other Empire cottons. In its present form this new hedge contract, which was opened to trading on 1st September, 1925, is not as well suited as it might be to the better classes of Indian cotton, and the modification of certain details is now under consideration. As a result of the large American crops of 1925 and 1926 the exports of Indian stapled cottons are temporarily of less importance than they have been in recent years, and in point of fact appreciable quantities of low-grade American cotton are now being imported into India. Nevertheless, in normal years India has a definite exportable margin of staple cottons, and it is clearly to the advantage of the cotton grower if such cottons can find a footing in the world's markets, whilst the interests of Indian spinners and Indian cotton growers alike demand that a larger portion of the Indian cotton produced should be of a type more generally acceptable to the cotton spinners of the world than is at present the case.

Reference has been made to the substantial *quantities of American cotton being imported into India.* In the past there has always been the risk that with such cottons that dreaded pest, the Mexican boll weevil, would be introduced into India, and should this occur the damage to Indian cotton growing might be very great. With effect from 1st December, 1925, all American cotton imported into India is required to be fumigated. For the present, its importation is restricted to a single port, *viz.*, Bombay, and fumigation is effected by means of hydrocyanic acid gas, special equipment and staff having been provided by the Government of

India for the purpose, the cost being covered by the fumigation fee charged to the importer. Prior to the issue of the notification the Indian Central Cotton Committee's investigations had shown the practicability and efficacy of such fumigation and had clearly indicated the conditions under which it should be carried out. The Committee has given advice on the various details which have arisen in regard to practical working and not only prepared the actual scheme for commercial fumigation but have lent the necessary supervising staff to see that the work is properly carired out. The larger American crops of 1925 and 1926 have led to the assumption in certain quarters that the boll weevil danger in America has been passed, and it has even been suggested that there is no longer any need to place any restrictions on the importation of American cotton into India. This is far from being the case. By means of somewhat drastic modifications in cotton cultivation, particularly by the replacement of old-established varieties by quick-maturing types and by chemical warfare against the pest itself on a scale never before attempted in the world, aided by favourable seasons, the damage done by the boll weevil in the United States has been reduced. But a comparison of the yields now obtained with those obtained in pre-weevil days does not indicate that the pest is by any means negligible, and in point of fact the danger of the introduction of the weevil into India has been but slightly reduced. It is particularly satisfactory to record that the experimental work undertaken by the Central Cotton Committee resulted in a practicable working scheme for the fumigation of all American cotton and that the scheme has worked successfully, the success in practical working being due in no small measure to the cordial co-operation of the Bombay Port Trust, acting in this matter as agents for the Government of India.

The Committee is able to record very definite progress on its research schemes. *The Technological Laboratory* recently completed its first year's normal working in its new buildings. The facilities offered to Agricultural Departments for practical spinning tests on new cottons have been welcomed and the Spinning Laboratory has been very fully occupied. Progress has also been made on the more purely scientific side, and a beginning has been made in the

study of those measurable characters of cotton which appear to have an important influence on spinning value. The correlation of laboratory results with actual spinning results should prove of increasing value as time goes on and as the necessary data are accumulated. Dealing with a non-uniform material such as cotton, the only practical method of approach would appear to be the collection of data sufficiently numerous to justify proper statistical interpretation, and this policy is being steadily followed. In the course of such work, and in order to provide the necessary standards of comparison, the Technological Laboratory undertook a number of spinning tests on standard Indian cottons, including pure strains and other selected cottons which the Agricultural Department has brought into cultivation on a commercial scale. These results have proved to be of considerable interest to Indian spinners and to the cotton trade in general, and a bulletin embodying the results of the first two years' work on these cottons has recently been published.

So far as new cottons are concerned the position is that a cotton breeder can now obtain a full spinning report on a 12 lb. sample of cotton. The number of samples received from Agricultural Departments for testing between April 1925 and March 1926 was 44.

The Institute of Plant Industry at Indore, for which the Central Cotton Committee provides the bulk of the funds, has recently completed its first full working year. The buildings and equipment have been completed and the institute's farm fully laid out, and plant breeding, physiological and agricultural investigations in connection with cotton growing on black soil areas are now in progress. The institute is also taking on research students appointed by the Central Cotton Committee. It is as yet too early to attempt to review the results obtained, but the institute is steadily developing the programme of work put forward by the Director when the provision of this central institute for agricultural research on cotton was decided upon.

The Cotton Research Botanist provided by the Committee for the Punjab took up his duties in July 1925. The special cotton laboratory, provided partly from the Committee's grant and partly by a grant from the Local Government, has been completed and is now in use. The scheme includes the provision of a small experi-

mental area immediately adjoining the laboratory and a cotton farm of 200 acres for large-scale work. Much progress has been made in laying out both of these areas and in studying the various types of Punjab cotton.

Further progress has been made with the *Committee's research schemes* in the Bombay Presidency on the *Earias* bollworm, cotton wilt, the physiology of the cotton plant at Surat and the improvement of Dharwar cottons by hybridization. The progress made in the three years' work was reviewed by the Committee recently and the schemes extended for a further period of two years in each case. The study of the life-history of the *Earias* bollworm in Surat and of the conditions which lead to the loss of crop now holds out hope of successful control measures, although the early indications that control by parasites would be practicable have proved to be unfounded. The cotton wilt investigation at Dharwar has yielded a considerable mass of information in regard to this disease and considerable progress has been made with wilt resistant strains. Much difficult work remains to be done before the real causes of the loss of crop by the disease can be said to be properly understood. The work at Surat on the loss of crop by cotton boll shedding is now approaching a stage when conclusions are possible, but so far no results have been obtained which can be translated into general agricultural practice. The improvement of Dharwar cottons by hybridization with Sea Island types has yielded results of considerable promise.

Satisfactory progress has also been made with the Madras research scheme on the study of the *herbaceum* cotton of that presidency. The method of work there adopted is the isolation and testing of pure lines from the local mixtures from which some promising strains have been obtained.

During the year the Committee reviewed the progress made on the work at Cawnpore on the control of the pink bollworm. Much of the necessary fundamental information has now been collected, and it is understood that this will be ready for publication during the coming year. Work on practical control measures is now well forward.

Work on the Committee's two research schemes in the Central Provinces and Berar on the improvement of the Oomras type of

cotton and on the cotton wilt disease has made considerable progress during the year, and there are now definite indications that strains of cotton have been obtained which combine with the hardiness and resistance to disease, so essential in this tract, a staple distinctly better than that of the present general Oomras type.

The Committee sanctioned last year three new research schemes, *viz.*, the Madras *Pempheres* and physiological research scheme, an investigation on the physiology of the cotton plant in Sind and a cotton-breeding scheme in Khandesh. The first scheme was referred to in last year's report and steps have been taken by the Madras Government, who have accepted it, to appoint a Botanist and Bio-Chemist and the necessary assistants. As regards Sind, the Government of Bombay have now established an agricultural experimental station at Sakrand to deal with the general problems arising from the provision of perennial irrigation in the large tract of country commanded by the Sukkur Barrage canal scheme. The Local Government have supplied the staff necessary for general agricultural work and for cotton-breeding, whilst the Central Cotton Committee has supplied funds for the employment of a Physiologist and staff, as in this area the water relations of the cotton plant promise to be of the greatest importance.

The Committee's grant to the Khandesh cotton-breeding scheme enables a more adequate staff to be employed for the development of work which has already shown considerable promise. Some very promising hybrids between *G. cernuum* and *G. indicum* have been obtained which, as spinning tests at the Technological Laboratory show, produce cottons suitable for spinning 20*s* to 30*s* counts, as compared with the 8*s* to 12*s* counts spun from the present Khandesh cottons. There is at present no instance in India of a hybrid cotton having been successfully introduced into general cultivation on a large scale, and it is essential that the new hybrids should be most exhaustively tested and the last stages of plant-breeding work carried out with meticulous care. The Committee's grant enables the necessary staff for this purpose to be employed.

Work for the improvement of cottons in the various provinces has continued mainly on the lines already adopted. The BOMBAY PRESIDENCY with an area of over 5 million acres of cotton includes five distinct cotton-growing tracts of which four are in the presi-

dency proper, the fifth being Sind. With the existing irrigation facilities Punjab-American cotton continues to do well in Sind, especially the Punjab-American varieties 4F. and 285F. which yield well in the Jamrao area. By further selection from Punjab-American cotton still more promising types have been obtained which are still in the experimental stage. New types of American cotton imported from America have yielded cottons of excellent quality, but the yields have been disappointing; these are now being used as parents for the production of hybrids with Punjab-American in the hope of obtaining high-yielding strains with long staple.

The Gujarat cotton tract falls into three natural sub-divisions. Work in the most southernly, the Surat, zone was started first, and the improved type Surat 1027 A. L. F. is now estimated to cover half-a-million acres and to have largely replaced other cottons in the tract south of the Narbada. North of the Narbada, the Broach tract proper is not entirely suitable for the Surat type, but much is expected from an improved type of Broach cotton with a staple one-eighth of an inch longer than ordinary Broach and with a ginning percentage 3·7 per cent. higher. This type, known as Broach 1 A. 9, is now being multiplied for general distribution. Upper Gujarat forms part of the great Dholleras area where the Wagad (the closed-boll) type of cotton is grown. As a result of selection work two pure strains of Wagad have now been obtained which are sufficiently promising to justify large scale testing and multiplication.

In the Karnatak the extension of the well-known improved types of Dharwar-American (Gadag No. 1) and Kumpta (Dharwar No. 1) has been continued with the aid of the Gadag and Hubli Co-operative Cotton Sale Societies which are organizing both the seed supply and the marketing of the produce. In both cases the Agricultural Department has now under consideration requests for the organization of much larger controlled areas for seed production to enable these societies to extend their operations. In the neighbourhood of Gokak a new hybrid cotton which combines satisfactory staple with a higher ginning percentage and better colour than previous Kumpta strains, is now being distributed and appears to be very promising.

A feature of the work in Bombay is the large scale organization of the seed supply. For Surat cotton the Agricultural Department makes itself responsible for the supply each year of seed for 100,000 acres, involving some 7,000 acres of controlled seed farms. In the Karnatak the seed multiplication areas are organized by the co-operative cotton sale societies, the department at present supplying certified seed for some 7,500 acres of each variety. In South Gujarat, the Baroda, Rajpipla, Sachin and Chhota Udaipur States obtain a certain amount of seed from the Bombay Agricultural Department annually and are spreading the same variety, Surat 1027, as the Bombay Department has introduced in the adjoining British territory. In Khandesh, pending the final tests on the improved types already referred to, the department is concentrating on the provision of pure seed of the high ginning N. R. type which is distributed through the medium of locally developed associations and co-operative cotton sale societies and through the branches of the Central Co-operative Bank.

In MADRAS, work on the further improvement of Cambodia cotton has been continued. The strain now known as Coimbatore No. 1 has been distributed for two years and it has been shown by spinning tests to be of very high quality, whilst it yields as much as 20 per cent. more than ordinary Cambodia. The area under this pure strain is now approximately 1,000 acres. Another strain Cambodia 440, also a high yielder which appears to be particularly resistant to pests, has been shown by spinning tests to be suitable for counts of 30*s* warp; this variety will be given out to private seed growers during the coming year.

The introduction of Cambodia cotton into Coimbatore and adjoining districts as an irrigated crop grown under intensive cultivation led to a higher standard of cotton cultivation in that tract. There is still a considerable area of unirrigated cotton cultivated, partly of the old Uppam variety of no particular merit, and partly of unirrigated Cambodia which is frequently uncertain as regards yield and quality. Considerable success has been obtained with Karunganni cotton from the Tinnevelly tract in this district; 4,000 acres in the Coimbatore District were under this variety in 1925-26. Private seed farms with an area of 800 acres have now been organized to provide for the seed supply.

Company cotton, a pure type of Karunganni, is being steadily distributed throughout the Tinnevelly tract, the seed supply being organized through the medium of seed unions and selected growers who gin their *kapas* co-operatively and sell the lint jointly. In this way pure seed sufficient for 30,000 acres was distributed in the three districts concerned (Madura, Ramnad and Tinnevelly) during the year under report. Karunganni is now the predominant constituent of Tinnevelly cotton.

Reference has already been made to the study of the *herbaceum* cottons. In the "Northerns" tract the introduction of Nandyal 14, an improved *indicum* cotton, was continued, approximately 13,000 acres being under this strain. The premium over ordinary Northerns received at the auctions organized by the department amounted to Rs. 14 per candy of 500 lb. In the "Westerns" tract the selected pure strain Hagari 25 was grown on 179,000 acres. The average premium realized on cotton sold by the department was Rs. 20-8-0 per bale of 400 lb. Ryots who sold their cotton in the ordinary way are stated to have obtained only Rs. 4 to Rs. 11 per bale premium owing to faulty market organization.

The bulk of the scientific work on cotton in Madras is still concentrated at Coimbatore, new strains being tested at the experimental stations at Koilpatti, Hagari, Nandyal and Guntur. Steps are now being taken to convert the above-named experimental stations into local cotton-breeding stations.

Reference has already been made to the research work which is being carried out for the improvement of CENTRAL PROVINCES AND BERAR cottons in co-operation with the Central Cotton Committee. It is now reported that a certain strain of the *neglectum verum* type which gives a yield of *kapas* equal to Roseum and is the best *neglectum* cotton in point of staple, has shown satisfactory resistance to wilt and has shown great promise on a field scale. Meantime the Agricultural Department has continued its policy of organizing the supply of Roseum cotton seed of satisfactory quality except in those areas where susceptibility to the wilt disease tells against it.

In 1925 the total area under cotton in the PUNJAB (excluding Indian States) rose from 2,326,000 to 2,702,000 acres of which 2,421,000 acres were irrigated. The increase since 1923 has

amounted to nearly a million acres, 544,000 acres of which were of American cotton. The area under Punjab-American cotton again expanded, reaching in the year under report 1,148,000 acres which is a new record. The bulk of this area was of the 4F. variety which was first distributed in 1913. the newer types 285F. and 289F.—both much superior to 4F. in staple—were grown on 10,450 and 5,500 acres respectively. The last named variety is the best of all in respect to staple and is also a heavy yielder, but it has not yet been established that it is suitable for ordinary cultivators' conditions, though it has done very well on large estates.

The Director of Agriculture reports that American cotton has brought very largely enhanced profits to the growers; but the future of American cotton in the Punjab is still threatened by the fraudulent mixing which goes on and by the export of mixed cotton which takes place on a large scale. This mixing threatens to ruin the reputation of Punjab-American cotton, and if the steps already taken do not check this practice, more drastic action will be necessary to protect the interests of the growers.

Work was continued on the improvement of indigenous varieties, and the area under the Mollisoni type, which is recommended for parts of the canal colonies where the irrigation supply is inadequate for American cotton, was extended to 87,500 acres. In the South-East Punjab where American cotton cannot be grown owing to lack of irrigation facilities the Agricultural Department supplied seed for 21,000 acres of a selection from the local cotton which is reported to be of fair staple; the total area under *neglectum* selections is now 55,800 acres. In all the Agricultural Department supplied seed to growers for some 221,000 acres, the greater part of its supply being drawn from large estates which undertake the multiplication of seed for the department.

In the west of the UNITED PROVINCES, where cotton cultivation is most dense, 30,000 acres are reported to be under Aligarh 19, a short-stapled cotton with a lint somewhat superior to the old Aligarh White-flower which it is replacing. In the Central Circle cultivation of the selected indigenous type J. N. 1 has increased by 50 per cent. Four new cottons from the Botanical Section have shown considerable promise; these are being

tested in different districts. One type in particular, which has yielded nearly 1,200 lb. of seed-cotton per acre and which the Technological Laboratory tests have shown to be suitable for spinning 22*s* counts, appears to be of considerable promise. For lack of the special irrigation facilities necessary, there appears to be no likelihood of any material extension of the area under Cawnpore-American cotton.

In BURMA the total area under improved cottons during the year under report was 8,785 acres. Cotton breeding work at Mahlaing was continued and a number of selections sent to the Technological Laboratory for spinning tests. Three of these are suitable for higher counts than the ordinary Wagale, and these are now under field scale trial and multiplication. A number of crosses between Shan and Wagale cottons show promise and are being further studied. The results with Cambodia cotton are still somewhat uncertain. The Cambodia cotton now grown at Thayetmyo is distinctly inferior to Madras Cambodia in staple, and it appears to be more susceptible than Wagyi to damage by pests. Both Cambodia and Wagyi cottons require improvement by pure line selection and this is being undertaken.

The Director of Agriculture, BENGAL, reports that it would be possible to introduce cotton into the high lands of West Bengal where a revenue crop is badly needed. Early maturing American types have shown more promise than local cottons and the best strains are being multiplied as rapidly as possible for distribution.

Now that a farm has been opened at Rangamati, a Chittagong hill tract, serious work on Comillas cotton will be possible. This cotton occupies a curious position as it is used entirely for purposes other than cotton spinning—such as admixture with wool. The present demand for it is considerable but is considered precarious. American cottons have been found to do well in the hill tracts, and the question whether the replacement of Comillas cotton by American would not be the wisest course is under consideration.

In the MYSORE STATE, the area under the selected strain No. 69 of the local *herbaceum* cotton was further extended during the year and arrangements made for an ample supply of pure seed. The new hybrid, Mysore-American 4, gave larger yields than either

Dharwar-American or Cambodia, and 300 lb. of seed of this variety has now been sent out for trial on cultivators' fields.

The policy of supplying seed of the valuable HYDERABAD Gaorani cotton was continued, the amount of seed distributed for sowing purposes during the year under report being sufficient for 212,000 acres. It is estimated that in the districts of Nander, Osmanabad, Parbani and Bir, 350,000 bales of pure Bani (Gaorani) cotton were produced during the season. Different varieties from other parts of India were tested at the experimental stations during the year but, with the exception of a selection from Akola which is reported to resemble the local Gaorani in essential characters, none appeared to be suitable for this tract. There is need for a thorough botanical study of the Hyderabad Gaorani variety which, though at present impure, is one of the most useful spinning cottons in India.

As already stated, the policy of the BARODA Durbar coincides with that of the Government of Bombay both in regard to the administration of the Cotton Transport Act and the introduction of improved varieties. Very substantial quantities of pure seed of the 1027 A. L. F. variety were distributed, and two cotton sale societies were organized during the year, whilst three more are under process of organization. The average extra profit which accrued to members by the sale of their cotton through the societies is estimated to be Rs. 47.

The small RAJPIPLA STATE in Gujarat deserves special mention, as the Durbar has succeeded in entirely ousting an inferior cotton and in replacing it by the Surat 1027 type obtained from the Bombay Agricultural Department. They have also introduced a Cotton Transport Act and regulations with respect to cotton ginning and pressing factories. The result is that Rajpipla cotton is not only no longer at a discount in the Bombay market but is much sought after, and, recently, on the recommendation of the Central Cotton Committee, has been made tenderable against the Surat standards of the East India Cotton Association.

IV. Sugarcane.

During the year under report weather conditions were generally favourable and the condition of the crop was reported to be good.

According to the final general memorandum issued for the year by the Department of Commercial Intelligence and Statistics, Calcutta, the cane acreage was estimated at 2,648,000 acres as against 2,532,000 last year, showing a 5 per cent. increase in area; while the yield of raw sugar (*gur*) was estimated at 2,930,000 tons against 2,546,000 tons in 1924-25, an increase of 15 per cent. in production. This estimate does not include some of the tracts where cane is grown on a small scale. In these tracts the average cane area for the last five years has been 158,000 acres and the yield of raw sugar (*gur*) about 174,000 tons. The production of refined suger in India by factories working direct with cane during 1924-25 amounted to 33,805 tons, as against 38,312 tons during the previous season. The output of refined sugar by modern factories working with *gur* during the same period was 32,592 tons, a decrease of 23,814 tons over the previous year. This was due to the unfavourable season, to an appreciable reduction in the acreage under cane and to the price of *gur* being high. Thus the total quantity of refined sugar produced in India during 1924-25 both by modern factories and refineries was 66,397 tons, as compared with 94,718 tons in 1923-24, a decrease of 28,321 tons over the output of the preceding year. This is exclusive of the sugar made by small establishments using the indigenous process of manufacture. India during the year under report imported from abroad 738,224 tons of sugar (including " browns " and " beet ") as against 670,965 tons during the previous 12 months ending 31st March, 1925. After deducting exports and re-exports as well as all stocks on 1st April, 1926, at the principal ports of India it is estimated that about 854,000 tons of imported and locally manufactured white sugar were consumed in India in the official year 1925-26, as against 709,000 tons in 1924-25, over and above the usual absorption of raw sugar (*gur*) made locally. Sugar prices ruled low throughout the year.

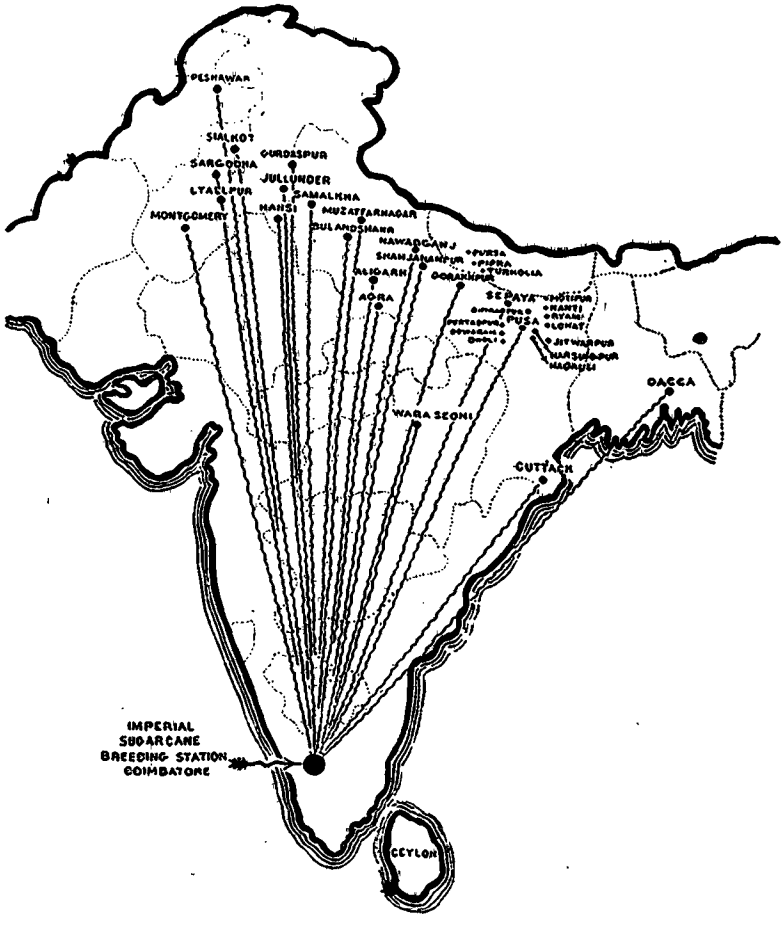
The CANE-BREEDING STATION AT COIMBATORE continued to do botanical work on cane with special reference to the breeding of new varieties. A second Cane-breeding Officer for work on thick canes was appointed by the Government of India to enable the work on thick canes to be taken up.

In the technique of breeding an important advance was made by the successful isolation of live cane arrows. In the past the inability

to protect treated arrows against undesired pollen has been one of the chief handicaps; but a study of the rooting system in canes enabled a satisfactory method to be developed during the year. This method consists in artificially inducing a fresh set of roots on the cane whose arrow it is desired to segregate, and subsequently transferring the cane to the desired locality, where the arrow develops in a normal manner and lends itself to the subsequent operations.

Methods of planting have also been evolved which enable the habit and tillering of the cane plant to be closely studied.

During the year work on crossing was continued with a view to removing the defects under which some of the Co. canes already distributed labour; Co. 205, for example, though an excellent cane in other respects, is a late variety which does not give a juice of good quality.



Certain of the more important places benefiting from Coimbatore work.

The work on "inheritance" studies was continued and the indications of inheritance which have now been obtained have been of practical use in working towards a desired type. Deeper-rooting cross-bred varieties have been evolved by using *Saccharum spontaneum* and Co. 205 as one of the parents, and canes of high sucrose content by using Co. 214, P. O. J. 2690 and P. O. J. 2725.

THE SUGAR BUREAU AT PUSA continued its work on the testing of new seedlings suitable for the white sugar tract in Northern India. It also imported for observation sets of Badila from Trinidad, D. 625 from British Guiana and P. O. J. 2714, 2725, 2727 and 2878 from Java. Assami Red received from the North-West Frontier Province was grown and examined. B. H. 10 (12) was obtained from Coimbatore along with the fresh batch of Co. seedlings and tried out with them. Co. 205 was propagated for distribution in low-lying areas, and Co. 275, 280, 290 and 273 were grown for bulk testing against Co. 213. Co. 213 and Co. 210 continue to spread in North Bihar; it is now to be hoped that some endeavour will be made by the mills to give a premium which will enable No. 214, the earliest of the Co. canes, to be grown on a large scale. Experimental work on the cultivation and manuring of cane was continued. The results prove that eye-to-eye planting in rows 3 feet apart is the best method for Co. 213 and canes of that type; while 2½ feet rows with the sets planted eye-to-eye is best for Co. 214, Co. 205 and other thin types. Closer planting than this interferes with inter-cultivation and therefore does harm in unirrigated tracts.

October planting was further tested against February planting; the results obtained tend to prove that better germination and a better stand can be obtained by planting in October, and that the crop is likely to escape damage in years of bad borer attack. Analysis also shows a percentage increase in the sucrose during the first months of the season, thus bringing October-planted cane into line with ratoons for early crushing. Co. 213 is now firmly established in North Bihar as the standard cane; in the east of the Gandak, Hemja is rapidly being supplanted for factory supply. It is now evident that a cane whose yield does not exceed Co. 213 in tonnage has little chance of being taken up in this tract. This

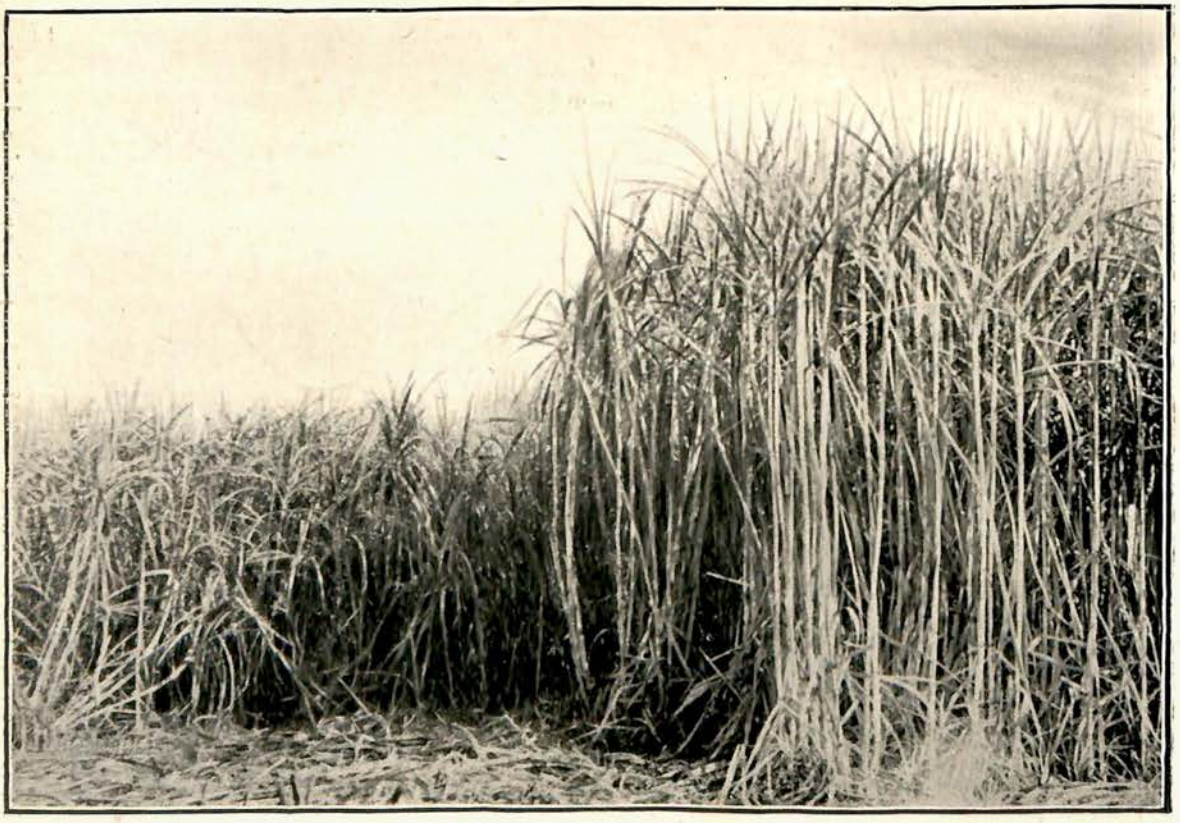
PLATE III.

COIMBATORE 205 GROWN IN A TANK, GOVERNMENT FARM, CUTTACK.

Planted—February 1926; first waterlogged—15th July; under water since 10th August; maximum height of water—6′ 7″ in September; 3 ft. water when harvested on 2nd January, 1927. Analysis—15·22 sucrose; glucose 0·64; purity 81.

PLATE IV.

The Sugar Bureau at Pusa distributing Coimbatore canes to the growers.



A SELECTION FROM NORTHERN INDIA. Co. 223.

Co. 223 is getting popular in the irrigated tracts round about Gurdaspur in the Punjab on account of its upright habit, heavy yield and resistance to frost.

brings into prominence the possibilities of Co. 281, the most promising of the new Co. seedlings under trial.

The use of sulphate of ammonia, nitrate of soda and sulfurophosphate among growers was on the increase and arrangements were made for the supply of 81 tons of seed-cane of the Co. varieties.

In the UNITED PROVINCES an area of 100,000 acres is reported to be under improved varieties. The most popular of the Co. canes under trial are Co. 213, 214, 204 and 205. Co. 244, 252, 281 and 290 also showed considerable promise on several of the experimental farms and on some selected private farms. There was an increased demand for centrifugals for making white sugar in the north and centre of the province, as growers consider that it pays better to make white sugar than *rab*.

In BENGAL, the testing of Co. 213 against Tanna is being continued. Tanna is a good yielder; it withstands jackals and pigs and is free from disease. Co. 213 gives a higher yield and a *gur* of better quality than Tanna, but it is not quite so hard in the rind and is therefore damaged to a greater extent by jackals. It remains to be seen whether these advantages will turn the scale and result in Co. 213 ousting Tanna.

In BIHAR AND ORISSA, Co. 213 and Co. 210 have done very well on the Gaya farm and have given good yields on land which has heretofore been used almost entirely for rice. On Bikramganj farm a large area of Co. 210 and Co. 213 has been put down to provide sets for distribution. In South Bhagalpur Co. 213 is doing well. Plate III is a photograph of Co. 205 cane grown in a tank on the Cuttack farm. It was planted in moist land towards the end of February 1926, and got water-logged in the middle of July. From the 10th of August it was standing in five feet of water, and at one time in September the crop was submerged to a depth of nearly seven feet. When harvested on the 2nd of January, 1927, the height of water was three feet; nevertheless the following remarkable analys s was obtained:—Sugar on cane 10·26, total solids 18·03, sucrose 15·22, glucose 0·64 and purity 81.

Coimbatore canes 205 and 223 continued to demonstrate their superiority over local canes in the PUNJAB. During the current season, when the cane-growing area around Gurdaspur suffered from a prolonged frost of unusual severity, the local medium cane

was practically completely killed wherever it was not possible to protect the crop with special irrigations, but the Coimbatore canes stood the trying period remarkably well.

In the NORTH-WEST FRONTIER PROVINCE, Assami Red introduced in 1917 continues to do well in tests against the local Paunda. Co. 213 grows with striking luxuriance, but being somewhat late, it does not ripen sufficiently early to give a good *gur*. The costs of cane growing were reduced by 30 per cent. by using tops for seed and a soil inverting plough for cultivating the land and earthing up the cane. Two imported new varieties of beet were also tried.

In BURMA, a farm for experimental work on cane has been opened at Pyinmana; it is provided with a power crusher and *jaggery* boiling furnace to enable it to carry out complete experiments. Work on the quantitative yield tests of indigenous and exotic canes and the effect of fertilizers on the yield and sugar content of cane is in progress.

In MADRAS, fifty acres of land have been added to the experiment station at Anakapalli in order to make it a cane-testing station for the presidency: on this farm 15 Co. seedlings were under trial in the year under report. At Samalkota, Anakapalli and Palur experiment stations some promising Java, Queensland and Barbados canes were under trial. The system of short-planting is on the increase and from the ryots' point of view the value of the additional yield averaged Rs. 15 per acre *plus* Rs. 10 saved in cost of seed. The increase in the yield of cane was found to be 22 per cent. Mosaic disease appeared for the first time; all possible efforts are being made to keep it under control. J. 247 was introduced with success into the 1st Circle, resulting in a heavier tonnage. This cane and Fiji B (Badila) found favour with ryots in Cumbum. The Sindewahi furnace was vigorously pushed; in Coimbatore District about 500 of these furnaces were being worked. A model Sindewahi furnace has been built on almost all the experimental stations in the cane-growing districts.

In ASSAM, work continued on the testing of varieties. Eleven new varieties were tested, most of which appear promising. At the Jorhat farm yields of 44 tons on the experimental area and 61 tons on the non-experimental area were reported.

In the CENTRAL PROVINCES, the improvement of sugarcane cultivation in Betul and Chhindwara is noteworthy, and there is an ever-increasing demand for improved varieties and iron cane mills. At Tharsa farm Co. 219, Co. 226 and Co. 239 proved the best of the 8 types under trial; Co. 219 gave 50 per cent. more *gur* per acre than the local Khari.

In MYSORE, experiments have proved the suitability of J. 33A for the Vainvilas sugarcane tracts. It has been proved too that a heavy crop of cane can be raised with the help of ammonium sulphate. Work on manurial experiments was continued during the course of the year with gratifying results.

In TRAVANCORE, yield tests were carried out on Government farms; cultural and manurial demonstrations were also conducted on ryots' land.

Fiji B (Badila), D. 74, B. 208 and Mauritius have proved promising at Kamareddy in HYDERABAD State.

Though it has not been possible to provide the money required for the Imperial Sugar Research Institute, the establishment of which was recommended by the Indian Sugar Committee in paragraph 372 of their report, the work on cane at Pusa has been reorganized, expanded and intensified with a view to achieving, as far as possible, the results which the Committee had in view. The Imperial Agriculturist is now in charge of the work of testing and propagating new varieties of cane. Other Heads of Sections are also giving much time to those problems in cane-growing in which they are specially interested. The Imperial Economic Botanist is testing cane seedlings obtained from Coimbatore. The Mycologist is investigating the cause of *mosaic* and other diseases which cane is heir to, and studying methods of prevention. The Entomologist is investigating the insect pests which take a heavy toll of the crop in Bihar. The Secretary of the Sugar Bureau brings the results of the work achieved at Coimbatore and Pusa to the notice of cane-growers in the provinces and arranges to supply them with seed from Pusa. Our experts at Pusa and Coimbatore are, in short, tackling India's cane problems in a manner in which they have never been tackled before. We believe that much of the work of testing new seedlings of thin and medium varieties evolved at Coimbatore can be transferred to Pusa at an early stage

of their evolution, and that by working as a team the expert staffs of these two institutes can, at a very small additional cost to Government, solve many of India's sugar problems.

V. Jute.

Although jute occupies only 1·3 per cent. of the cultivated land, it contributes 26 per cent. of the export trade of the country. With the revival of trade after the depression of the war and post-war period, there is a growing demand from all sides for jute manufactures, and the area producing the raw product has gradually risen to the figure of the quinquennium immediately preceding the Great War. As both the area sown and the probable outturn for 1925 were under-estimated, record prices were obtained by the growers, with the result that the area of 3,630,000 acres sown in 1926 showed an increase of 15 per cent. The total weight of raw and manufactured jute exported decreased from 15·1 lakh tons to 14·6 lakh tons; but, owing to the higher prices received, the value of the exports increased from Rs. 81 to 97 crores.

As India at present enjoys a monopoly in jute production its cultivation should continue to be a profitable industry. In BENGAL, where lies 85 per cent. of the area under this crop, *capsularis* D. 154 and *olitorius* Green Chinsura, originally isolated on the Dacca farm, are heavy-yielding types of their respective kinds. There is a big demand for seed, and the 110 tons available during the year met only 33 per cent. of the requisitions received. It is reckoned that the improved Dacca varieties already occupy nearly 3½ lakhs of acres or 13 per cent. of the total area under jute in the province. As the Indian Jute Mills Association and the London Jute Association have come forward to help the department financially in its work of propagating and distributing seed, a large increase in the area under the improved varieties is expected.

Manurial trials at Dacca indicate that on red soils the application of lime, bone and potash at an average annual cost of Rs. 18 per acre is a profitable investment, resulting as it does not only in a material increase in the yield of jute but also in that of other crops in the rotation.

Consequent on the demonstration at Purnea of the economic superiority of Green Chinsura over the local *olitorius* varieties

cultivated, a large demand has arisen in the jute tracts of BIHAR for the seed of the Dacca selection. Considerable quantities of seed of the well-known Kakya Bombai jute are being distributed through co-operative societies.

D. 154 and Chinsura Green again proved to be the most productive varieties under trial in ASSAM. Over seven tons of seed of these jutes were distributed to the cultivators. The earlier Bengal selections, Kakya Bombai and R. 85, are now being grown on large areas in the Upper Assam Valley.

In the Ganjar tract (Kheri and Sitapur Districts) of the UNITED PROVINCES, where conditions are similar to those obtained over large areas in Bengal, jute cultivation has been thoroughly established through the efforts of the Agricultural Department. Jute has proved more profitable than any other crop previously grown, and as the marketing of the fibre has also been placed on a sound footing, the area is increasing fairly rapidly.

VI. Other Fibres.

Hemp. The term hemp is used to denote the fibre of at least four important crops which are grown in India, *viz.*, *Cannabis sativa*, *Agave sisalna*, *Hibiscus cannabinus* and *Crotalaria juncea*. It is, however, the last named, known generally as sann-hemp, which is of most importance. The discovery made at PUSA that the same crop of sann-hemp can be economically used for the double purpose of green-manuring and for the production of fibre by ploughing in only the tops and retting the stems, should greatly stimulate its cultivation. With a view to encouraging its spread in provinces where sufficient water is not available for retting purposes, a method of artificial extraction of the fibre is also being worked out. In the UNITED PROVINCES, the seed of an improved variety of sann-hemp named Cawnpore 12 has been distributed with encouraging results.

The races of sisal hemp which pole early have been separated at DACCA from those which pole late. As the latter are more profitable fibre producers than the former, they are being propagated.

An investigation into the factors which influence the sex ratio in the true hemp *Cannabis sativa* has been started at Pusa.

Sida. Samples of sida fibre sent to Dundee for appraisement have been declared suitable for replacing jute in the manufacture

of fine fabrics. Though sida cannot compete with jute in yield, it can be grown in tracts where the incidence of rainfall will not suit the latter.

VII. Tobacco.

The most important tobacco tracts are to be found in the provinces of Madras, Bengal, Bihar, Burma and Bombay where on an average a million acres are occupied by this valuable crop. The indigenous varieties mostly cultivated give a product which is good enough for *hookas* and *biris* but is not suitable for the manufacture of cigarettes which have come much into vogue in recent years. The extent to which Virginian and other foreign types of tobacco have acquired a hold on the smoking taste of the people, can well be imagined when it is mentioned that the quantity imported during the year under review was valued at Rs. 2,13 lakhs. If a tobacco possessing the flavour of the imported Virginian cigarette can be grown and manufactured in India, there is a vast field both for internal consumption, and the extension of the present export trade to the tune of Rs. 1,11 lakhs; for Great Britain, which is the principal manufacturing centre, has reduced her customs duties on Empire-grown tobacco. The position is, to a certain extent, simplified by the fact that the type for which there is a keen demand abroad would also meet the requirements of an indigenous cigarette industry. The production of a tobacco of the colour, flavour and texture of that which is commonly called Virginian is the aim kept in view by our Agricultural Departments; but they are working at a disadvantage at present in not possessing sufficiently definite information regarding markets and grades. Moreover, there is no expert in curing on the staff, who has had experience in producing and handling higher grade qualities of tobacco. The Board of Agriculture in India, which met at Pusa in December 1925, therefore recommended the appointment of a curing expert and the establishment of a Central Tobacco Bureau which would remain in touch with the requirements of the trade and coordinate the work in progress in different tobacco-growing provinces. These proposals are at present under the consideration of the Government of India.

Further trials at PUSA with the American tobaccos Adcock and

Burley have shown that these exotics can be successfully grown in Bihar, and that it may be possible to produce a bright coloured tobacco by the curing methods devised. Success has been attained in curing Adcock to the required colour. The smoking and burning qualities of the tobacco cured have been pronounced to be very good. It seems that in districts which are liable to moist winds during the curing season, the desired result can only be attained if some method of controlling air temperature and humidity is devised. The first hybrid generation of crosses between American tobaccos and the best of the Pusa types (No. 28) was grown and studied.

The Sumatra tobacco acclimatized on the Burirhat farm in BENGAL has established its reputation as a cigar wrapper, and a demand for seed of this variety has arisen. Several American types of tobacco are grown on the farm, and flue curing and firing are being attempted with a fair amount of success. Matihari and Bhengi, the two selections made from indigenous types, are spreading at a considerable rate even into tracts which have not hitherto grown tobacco on a large scale.

The superiority of the Bengal selection Matihari over the local varieties is recognized in ASSAM too, and its cultivation is gaining ground.

The most important tobacco problem in BURMA is the curing of the leaf, and a special tobacco station has been established at Sa-aing to test different methods.

The tobacco strain (Gandiu No. 6) isolated on the Nadiad farm in BOMBAY has proved a heavy yielder.

The cultivation of the American varieties of tobacco introduced by the Indian Leaf Development Co., is spreading in the Guntur District of MADRAS, where there are now 5,000 acres under Adcock and White Burley. Encouraging results have been obtained in trials with potash manures for this crop.

The American tobaccos Adcock and Burley have been introduced on the Tarnab farm in the NORTH-WEST FRONTIER PROVINCE, where they are reported to have grown to perfection.

VIII. Oil-seeds.

Over 8 per cent. of the total cultivated area in India is on an average cropped with oil-seeds, *viz.*, linseed, rape, mustard, sesamum,

groundnut and castor-seed. There was a shrinkage in the acreage under all other oil-seeds except groundnut; but with a rise of 35 per cent. in the case of the latter the total area of 19,395,000 acres was lower than that of the previous year by 370,000 acres. The total outturn also declined from 3,842,000 tons to 3,775,000 tons. The quantity of oil-seeds (including cotton and *mahua*) exported during the year was 1,250,000 tons (valued at Rs. 29,63 lakhs), as against 1,328,000 tons (valued at Rs. 33,16 lakhs) for the previous year. The quantity of oil-cakes exported was 191,000 tons, as against 195,000 tons last year. While the area and yield show little variation from the average of the five years ending 1914-15, the exports of whole seeds are below the pre-war average by 203,000 tons. More oil-seeds are being crushed locally, but the increased quantity of oil-cakes produced is not all used in the country either as a cattle food or a manure, for we sent overseas during the year under report 51,000 tons more cakes than in pre-war years.

Linseed. The United Provinces and Bihar between them carry half the total acreage under linseed, but the types grown are inferior as regards size of seed and oil-content to those grown in Peninsular India. As both classes also differ in their root-systems, hybridization is being employed at PUSA to produce a large-seeded race with a root-system suited to the conditions of growth in the alluvium. The first hybrid generation has been raised and is under study. The two superior types, No. 12 and No. 121, selected from the unit species, are much in demand in Bihar. Type 12 is finding favour among also the cultivators of KASHMIR State.

A rust-resistant and higher-yielding variety is aimed at in the breeding work in progress in the UNITED PROVINCES.

Castor. Races of castor, superior both as regards yield and oil-content, have been isolated in the UNITED PROVINCES. In BOMBAY, selections are being made with the same purpose in view.

Sesamum. Over 100 preliminary selections have been made from different varieties of sesamum collected at PUSA for the isolation of unit species.

Mustard. The 42 varieties of mustard collected on the Jorhat farm in ASSAM for selective breeding from the point of view of yield, have given 74 pure types. Of the latter, one red, one white and one yellow are the most promising. The high-yielding races of

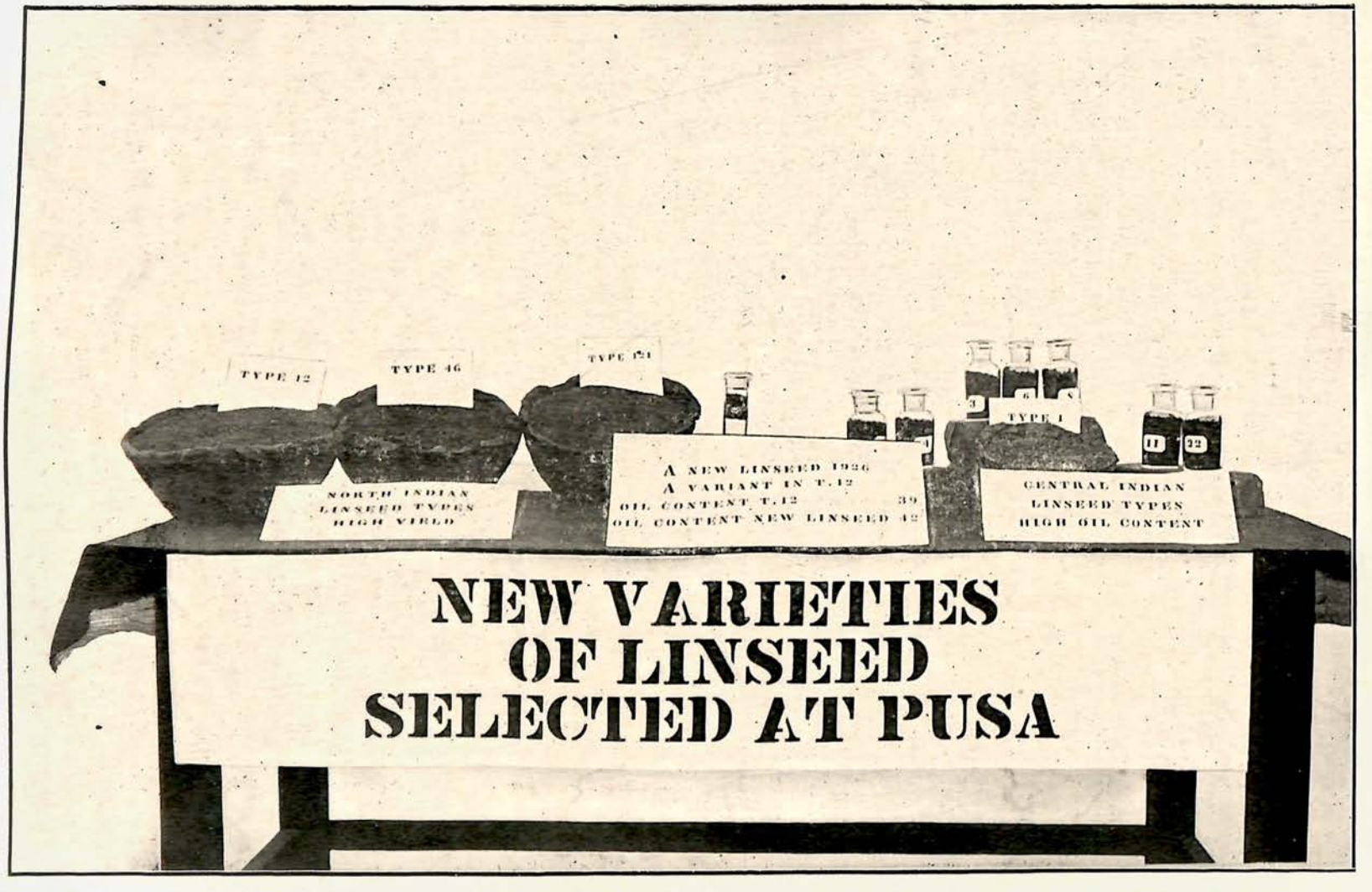

TYPE 12
TYPE 46
TYPE 121
TYPE 1
NORTH INDIAN
LINSEED TYPES
HIGH YIELD
A NEW LINSEED 1926
A VARIANT IN T.12
OIL CONTENT T.12 39
OIL CONTENT NEW LINSEED 42
CENTRAL INDIAN
LINSEED TYPES
HIGH OIL CONTENT
NEW VARIETIES
OF LINSEED
SELECTED AT PUSA

PLATE V.

mustard fixed in BENGAL are being multiplied for distribution in selected areas.

Groundnut. Sixty-four per cent. of the area under groundnut is in MADRAS where a new experiment station for the study of the crop was opened during the year at Palakuppam.

The area under groundnut in BOMBAY has, in one year, risen by 69 per cent. The most remarkable development has been in Khandesh and Upper Gujarat where, owing to the introduction of early maturing varieties, the acreage has expanded from 4,500 in 1912-13 to 373,000 in 1925-26.

In the CENTRAL PROVINCES, groundnut is gaining in popularity for cultivation in rotation with cotton. On the Powarkhera farm, early groundnut followed by irrigated wheat has proved to be a paying combination.

The superiority of the erect types introduced into BURMA over the local spreading variety in respect of earliness, oil-content and low cost of harvesting the nuts remains unquestioned, but there are conflicting reports regarding their yielding qualities. Investigations have therefore been started with a view to ascertaining the possibility of growing a second crop after the erect types. At Mahlaing, varieties recently introduced from Nigeria gave an average yield of 1,200 lb. of nuts to the acre.

Groundnut has become an established crop in part of the Patna Division in BIHAR, the area being gradually extended by demonstration. The demand for gypsum as a manure for this crop is increasing; 150 tons were so used during the year. In Chota Nagpur, a considerable demand has grown up for that type of groundnut known as No. 17, a selection from the Kanke farm. Groundnuts grown in light soils of the KASHMIR State are reported to give a net profit of Rs. 370 per acre.

Coconut. At Nileshwar and Pilicode in MADRAS, coconut palms which have not been artificially irrigated since they were planted in 1918 and 1919, have begun to bear fruits. The dry system of cultivation evolved at Kasargod in which deep cultivation in the first instance is followed by shallow cultivation repeated frequently during the hot weather to conserve the soil moisture, has proved a complete success. The system is applicable to thousands of acres of land lying waste in South Kanara, and is therefore being demon-

strated by the department. The area under coconuts has in consequence increased by 6,000 acres in Malabar and 3,000 acres in Kanara during the last six years, while the demand for seedlings is several times greater than the supply.

Seed selection from high-yielding palms being of little use, palms selected for high yield and good growth are being self-fertilized at Kasargod with a view to raising the seed thus obtained to maturity and studying the inherited characters. Other lines of research in progress are manurial trials, spacing experiments and a test to discover the optimum age of the seed mother palm.

Coconut gardens have been laid out on the Akyab and Kyaukpyu farms in BURMA, for collection of data regarding the best method of cultivation of the palm in Arakan.

The experiments with coconuts both at Cuttack and Balasore in ORISSA seem to indicate that good cultivation and manuring are essential for any considerable extension of the area outside their present habitat. The land acquired for a coconut farm at Puri is being planted up.

In TRAVANCORE, manurial and spacing experiments were continued and a large number of disease-resistant coconut seedlings sold from the Alleppey farm.

The introduction of parasites for the control of the coconut caterpillar *Nephantis serinopa* has proved a marked success in the affected areas of MADRAS. The pest is, however, spreading into new localities owing to the careless transport of infected material, and the operation of the Pest Act has been extended to the whole of South Kanara.

IX. Tea.

Eighty-two per cent. of the total area under tea lies in Assam and the two contiguous districts (Darjeeling and Jalpaiguri) of Northern Bengal, while the elevated region over the Malabar Coast in Southern India contains 14 per cent. The area of 728,800 acres occupied by the tea bush during 1925 was nearly 2 per cent. greater than in the preceding year. Although the area plucked was also higher by 6,000 acres, the estimated yield of 363,507,000 lb. worked out at 529 lb. as against 550 lb. in 1924. The reduction is due to the gradual abandonment of coarse plucking which has

become unprofitable in the absence of a demand for poor grades marketed in Russia before the war.

There was a slight falling off in the record average price of almost a rupee per lb. obtained in the previous year, but the industry continued to prosper. The exports, by sea, of 326,545,000 lb., valued at Rs. 27,12 lakhs, were higher than the pre-war average by 37 per cent. in quantity and by over 100 per cent. in value. In addition, 10,769,500 lb. were sent out by land. The bulk of India's production is thus absorbed abroad, but local consumption is also gradually increasing.

The scientific staff of the Indian Tea Association has been investigating not only problems relating to the improvement of yield through soil treatment and the control of diseases and pests, but also those connected with the quality of tea. The effect of plucking and pruning on quality appears to be correlated to the fact that leaf plucked off a long growth of new wood is inferior in tannine content to that plucked close to the old wood. Certain yeast cells naturally present on fresh leaf, which are known to improve the quality of tea manufactured, have been observed to decrease considerably in number in dry seasons and to increase as the humidity of the air rises. By proper pruning it has been found possible to avoid the stem diseases common in the Surma Valley.

In SOUTHERN INDIA, where tea is gradually replacing coffee in some places, the crop is dealt with by the scientific staff of the United Planters' Association. The tea experiment station at Peermade has been shut down, and a new one opened at Nellakotta in charge of the newly appointed Tea Specialist. Earlier pruning in August or September, instead of in December as is the general practice, has been proved to be an effective remedy against branch canker. For the prevention of die-back, pruning wounds are treated with Bordeaux paste or coal-tar. Neither spraying nor manuring with potash has proved effective against *Helopeltis* bugs.

X. Coffee.

The coffee industry in India is practically confined to a tract in Southern India, comprising part of the Madras Presidency, Coorg

and the States of Mysore, Travancore and Cochin. The total area reported under the crop was 148,697 acres—an increase of 4 per cent. over that of the preceding year. The production of cured coffee fell from 30,475,644 lb. to 22,106,717 lb.; there was a sympathetic decline in exports from 242,000 cwt. to 205,000 cwt. The poorness of the yield was, however, counter-balanced to some extent by the high prices obtained.

The variety of coffee ordinarily grown in India is Arabica, but Robusta coffee is coming into increasing prominence owing to the vigour with which it grows on poor lands. Kent's hybrid having established its superiority both in yield and disease resistance over Jackson's hybrid at the Sidapur station of the United Planters' Association of SOUTHERN INDIA, is now planted on a larger scale than any other variety of Arabica coffee. Spraying with Bordeaux mixture has proved very effective against leaf diseases, and its general adoption as a routine practice on coffee estates is only a question of time.

In the MYSORE State, which carries over 50 per cent. of the total area under coffee, a special station has been established at Balehonnur to carry on research on the lines pursued at Sidapur.

XI. Rubber.

With the restriction in production and consequent rise in price, rubber, which is grown mainly in Southern India and Burma, has come into its own again, and the industry is once more in a flourishing position. In the year under review the area under rubber amounted to 132,570 acres, which is 2 per cent. above that of the previous year. From the 93,528 acres tapped, 19,970,188 lb. of raw rubber was obtained, as against 15,601,296 lb. from 81,918 acres in 1924-25. Though the quantity exported to foreign countries (22½ million lb.) increased by 24 per cent. only, the value (Rs. 2,94 lakhs) rose by 106 per cent.

In SOUTHERN INDIA, the two rubber stations at Mooply and Tenamalai have been shut down, and a new one directly under the Rubber Specialist of the United Planters' Association has been opened at Mundakayam. The spraying of Hevea with Bordeaux mixture as a protection against *Phytophthora*, the fungus which causes the secondary leaf-fall, has now become a general practice

on most of the estates. The anti-drip device devised by the Rubber Specialist for reducing the loss of crop during the monsoon is also coming into use. The investigations in progress relate to the incidence of stripe canker and brown bast and the difference in yields obtained by deep and shallow cuts.

A survey of the diseases occurring in the rubber estates of BURMA has been carried out by the Mycologist of the Agricultural Department, and the results embodied in a bulletin.

XII. Fruit.

There are several important fruit-growing areas in India where fruit trees are cultivated on a large scale, but the industry is still carried on on primitive lines. The isolated efforts made by a few officers of the Agricultural Department to popularize better varieties of fruits and improved methods of cultivation, have given good results, but a great deal remains to be done before any great advance in fruit production can be achieved. A survey of the varieties of the various kinds of fruits grown, of the methods of propagation used by the people, and of the systems of transporting and marketing fruit in vogue is required. The relation of the root-development of the various species of fruit trees to the soil type, water-supply, and soil-temperatures also remains to be determined. Moreover, a thorough investigation is necessary into the economics of fruit-growing as a subsidiary industry for small-holders, or as an occupation for men of the educated classes who are in search of employment but do not take kindly to other branches of husbandry. The creation of a special horticultural section in the Imperial as well as in Provincial Departments of Agriculture is very essential. The only two provinces which have hitherto taken steps to create such a section are Bombay and the Punjab.

In the NORTH-WEST FRONTIER PROVINCE, a great deal of work has been done in the direction of discovering the best stocks for the orange and in establishing superior exotic varieties of peaches, plums, pears and apricots. The budded plants of these varieties are much in demand; nearly 30,000 trees were sold last year from the Tarnab farm. A large number was supplied to the private nurseries started by certain old employees of the farm.

With a view to demonstrating to the frontier trade the possibilities of improved methods of fruit culture, a commercial orchard of 57 acres has been planted up at Tarnab with varieties selected on the farm. Some of the trees are expected to yield a light crop in 1927. An inter-crop of sugarcane was grown during the year in a block planted with peaches in February 1925. Although heavily shaded by the sugarcane, the young trees flourished wonderfully, and the yield of *gur* from the cane worked out at Rs. 300 per acre.

The 2½-acre Arabian date plantation at Muzaffergarh in the PUNJAB yielded an income of Rs. 328, as against an expenditure of about Rs. 38. Promising results have been obtained with a method of curing, by artificial heat, partly ripened fruits which would otherwise have been spoilt by rain. A method has been worked out, too, for preserving in the form of a cordial the juice of the sour lime, which is grown abundantly in the Lyallpur District. With the appointment during the year of a Fruit Specialist, the subject of fruit culture will henceforth receive systematic attention in this province.

Over 8,000 plants were issued during the year from the fruit station at Quetta in BALUCHISTAN, which is now able to pay its way. The fruit boxes and crates designed by the Howards when in charge of this farm have been taken up by the trade; the introduction by them of suitable methods of budding, nursery management and orchard cultivation has stimulated fruit growing in Baluchistan to a considerable extent.

On account of the poorness of the mangosteen crop, only 66 per cent. of the expenditure on the pomological station at Coonoor and the fruit gardens at Burliar and Kallar in MADRAS was covered by receipts. The small fruit orchard started at Taliparamba has demonstrated that rose apples, loquats, sapota and fruits of the citrus family will grow very well under West Coast conditions.

The use of cold storage as a means of preserving fruit is under investigation in BOMBAY. Green mangoes which had been in cold store for a month, at a temperature of between 36° and 40°F., took six days to ripen after withdrawal, and kept good for ten days more. They were at the end of this time very attractive in colour; as good, in fact, as naturally ripened mangoes.

Several fruit trees of temperate and sub-tropical zones are being tested at Chhindwara in the CENTRAL PROVINCES for their fruiting capacity under semi-tropical conditions.

In ASSAM, experiments are being carried on by Mr. Holder, who has taken a lease of the Shillong fruit farm from the Government. The grafted fruit trees of this orchard are in considerable demand in the province.

The 30-acre horticultural garden at Hmawabi in BURMA has been planted up with different varieties of fruit trees. A portion of the Kyaukpyu farm is also being utilized for laying down an experimental orchard.

Observations made on loquat trees in the Botanical Area at PUSA have indicated that both Pale Yellow and Golden Yellow varieties are self-sterile, and that one will only set fruit when pollinated from the other. Calcium cyanide was demonstrated during the year to be the most effective chemical of the various insecticides used against mango-hoppers. The use of " sticky bands " has proved a very cheap and most efficacious method of dealing with *Monophlebus* sp. which is a serious pest on certain fruit trees.

In Bombay, orange trees growing on clayey soil and suffering from a die-back disease received much benefit when trenches were dug between the rows.

XIII. Fodder Crops and Grasses.

The extension of the area under food and other crops has resulted in the curtailment of that formerly retained for grazing. The ever-increasing pressure on the land due to an increase in population has brought about a decrease in the supply of foodstuffs available for the cattle population, and over considerable areas in India the cattle have, within the last 50 years, deteriorated to some extent. Poor cattle result in a low standard of tillage, and a low standard of tillage results in the reduction of the total available fodder. As the provision of good quality fodder in sufficient quantity is a question that has thus assumed great importance in the agricultural economy of the country, the Agricultural Department has of late years given much attention to the question of growing and storing fodders. Luscious fodders unknown in India 20 years ago such as berseem (Egyptian clover) have been

introduced and methods of storing green fodders in silos adopted. It has been definitely proved on the Government farms now dotted over the country that palatable ensilage can be made at little cost in pit silos from coarse grasses, weeds and other herbage which are available in considerable quantities towards the end of the rains. Feeding tests at Bangalore have established the fact that cattle will eat only enough spear grass hay to maintain themselves, but will readily eat large quantities of silage made from it.

Among the new fodder crops introduced in this country, the most valuable is Egyptian clover or berseem. It is now being grown successfully in Sind, Bihar, the Central Provinces and the North-West Frontier Province. At PUSA, a large area of irrigated land is laid down to berseem every year, after which a second crop of early maize is raised. The soil is enriched to such an extent by the clover that large yields of maize are obtained on rather poor land without manure. The berseem is mostly grazed by tethering the cattle in the field. The area of 103 acres sown with berseem during the year under report supplied full pasturage for a dairy herd of 350 head from November to May, and provided 41.0 tons of green stuff for cutting and feeding in the byre. Some good clover seed was produced during the year from a plot reserved for the purpose.

An economic method of storing green fodder as silage has for many years been practised at Pusa. During the year under report 740 tons of green maize were shredded and stored in *kutcha* pit silos which were covered merely with a layer of litter and earth. When the pits were opened, the loss in weight was found to be only 14 per cent.

In BENGAL the Japanese millet (*Panicum crusgalli*) promises to prove suitable as a fodder catch-crop. Natal grass is being tried at Dacca for the establishment of a pasture.

Guinea grass and Elephant grass have done well in ASSAM There is a good demand from the cattle-owners of the Assam Valley for clumps of Guinea grass for planting; these are being supplied from the Jorhat farm. The pit silo has proved a success on the Upper Shillong farm.

At Mahlaing in BURMA, *saccoline* (a sweet variety of fodder *juar*), introduced from New South Wales, has been crossed with

PLATE VI.

MALE YOUNG STOCK ON THE KARNAL FARM, EATING COARSE GRASS SILAGE.

BERSEEM CROP ON NEW RECLAIMED LAND, PUSA.

ordinary *juar* with the object of obtaining a hybrid strain having a sweet stalk and the superior grain of the local sorghum. Among the exotic grasses under trial at Tatkon and Akyab, Merker grass promises to be the best.

Sunflower, *saccoline* and the small bamboo (*Dendrocalamus strictus*) introduced on the cattle farms of the United Provinces, are giving promising results. Demonstrations in silage-making carried out in villages of the Muttra District created a great impression among the zemindars.

The value of *shisham* (*Dalbergia sissoo*) silage as an emergency fodder has been proved at Lyallpur; it has, moreover, been established that the silage does not deteriorate on being kept in the pits for two years. An ordinary ensilage pit filled four years ago with green *juar* was opened this year at Hissar; there was very little top waste and the animals ate the whole of the silage with relish. Berseem grown on the Hissar farm yielded 28 tons of green fodder per acre. This clover has been found to be a heavier yielder than either *senji* (*Melilotus parviflora*) or *methi* (*Trigonella fœnum-greacum*) commonly grown in the province. The newly appointed Fodder Specialist has under test various pasture grasses of which Elephant grass promises to prove suitable for rain-fed tracts.

As berseem seeds freely in the NORTH-WEST FRONTIER PROVINCE, it has been rapidly taken up by the cultivators and is now as commonly grown as the much earlier known shaftal. Berseem gives larger yields of fodder, and is less liable than shaftal to cause hoven in cattle. The Kikuyu grass introduced from South Africa is reported to have solved the pasture problem on the Tarnab farm. It provides pasturage for the whole of the farm stock numbering about 60 cattle and 75 sheep. The early maturing Teff grass from Africa has proved suitable for high class hay, but as it lacks bulk, it cannot be economically fed to cattle.

Success has been attained on the Adhartal farm in the CENTRAL PROVINCES, in getting berseem to set seed of excellent germinating power. The farm should be able in future to supply most of the seed required by the department. The improvement of the grazing and grass areas of the province and, in particular, the control of spear grass, is being investigated.

The renovation of poor pasture lands is being attempted in BOMBAY. Methods of storing *juar kadbi* (dried sorghum stalks) on a large scale in years of plenty are also being studied. Among the fodder crops introduced, *shevri* (*Sesbania aegyptiaca*) and Elephant grass are particularly promising. The former gives repeated cuttings and thrives on land considerably affected by *reh*. The latter grown on land manured with sewage effluent has given as much as 56 tons of green fodder per acre.

In MADRAS, an investigation into the possibility of crowding out spear grass by introducing better varieties has been taken up at Hosur.

XIV. Juar (Sorghum).

From the point of acreage, *juar* occupies a place only next to rice and wheat, covering as it does 30 million acres on an average. The principal *juar*-growing tracts are in Bombay, Madras, the Central Provinces and Hyderabad State, where this grain forms the staple diet of a large section of the population.

In BOMBAY, improved grains of *kharif juar* have been obtained by selection at Dharwar, Surat and Larkana, and strains of *rabi juar* at Broach. The demonstration of ridge cultivation on an area of 100 acres has, in Lower Gujarat, given a great impetus to the adoption of this method of growing *juar*. The average increase of yield from ridge cultivation is reported to be 20-35 per cent., and the method is applicable to lakhs of acres of black soil on which *juar* suffers at present from water-logging. In the arid tracts of the Deccan, the application of green manure results in very largely increased yields of *juar*, owing probably to the increased retentive power which it gives to the soil.

Among the three varieties of *juar*, *viz.*, Saoner, Ramkel and Lamkansi, under distribution in the Central Provinces, Saoner is the best from the point of view of yield. The selection work at Akola has yielded some promising new races which are in the process of multiplication.

In BURMA, the variety of outstanding merit is Aispuri which gives on an average 2,760 lb. of grain and 7,630 lb. of fodder per acre. New varieties have been imported from America for yield tests at Mahlaing.

As the result of departmental propaganda *juar* seed for sowing is now treated on a large scale in some parts of India with a solution of copper sulphate to prevent an attack of smut. In the Central Provinces where the use of dry copper carbonate is also recommended, arrangements have been made for the sale of this chemical in 1 oz. packets. The cost of this method of treating the seed comes to one anna per acre. Seed immersed in a solution of sulphate of copper deteriorates in germinating power if not sown at once; but that treated with carbonate can safely be stored for future use.

In Bombay, the ploughing up of the stubble as soon as the crop is harvested and the complete drying of the *kadbi* before stacking are recommended as effective precautions against the depredations of the *juar* stem-borer.

XV. Ragi (Eleusine coracana).

Seventy-two per cent. of the acreage (67 lakhs) under *ragi* is in Madras and Mysore. In the latter State, where *ragi* is the premier cereal crop, variety H. 22 isolated on the Hebbal farm has, on account of its heavy-yielding and drought-resisting powers, become fairy well established over a large area. There is, however, a demand in certain localities for a heavy-yielding variety which will ripen somewhat earlier than H. 22, and further breeding work is directed towards that end. Some types superior to H. 22 in yield have been isolated; but success has not yet been attained in combining in the same strain cropping power with early maturity.

Considerable progress has been made at the Millets Breeding Station in MADRAS with the study of the *ragi* crop, and a number of single plant selections have been made and are being tested for yield.

In the uplands of the Konkan in BOMBAY, where *ragi* is the principal food crop, a special station has been established for breeding superior types. A strain called E. 31 has been isolated which is consistently giving a large increase in yield over the other varieties under trial.

XVI. Potatoes.

The value of the potato as a food crop is thoroughly recognized in this country. A rapid extension of the area is, however, handicapped by the difficulty experienced in obtaining disease-free seed. If the losses in storage during the prolonged hot weather could be prevented, the price could be so reduced as to bring potatoes within the reach of the poorer classes. The problem of disease control, both in the field and during storage, is being tackled in several provinces.

The varieties of potatoes acclimatized and selected on the Upper Shillong farm in ASSAM have achieved popularity both in the hills and in the plains. Among the older selections, King-of-Potatoes stands first as regards yield, while of the newer importations Arran Chief and British Queen are the most promising. An application of 5·5 tons of cowdung produced in the year under report a crop of 3·3 tons; applications of other fertilizers did not increase the yield. Spraying experiments against the potato blight are in progress.

A farm has been established at Farrukhabad which lies in the potato-growing tract of the UNITED PROVINCES. The object in view is to investigate the scope for raising heavy and profitable crops and to test methods of storage. It is proposed to instal a small ice factory on the farm, with a view to ascertaining whether the satisfactory results obtained with cold storage at Cawnpore are applicable on an extensive commercial scale.

In BOMBAY, dusting with sulphur has proved very effective against the mite which causes the *tambera* disease of the potato.

A number of varietal and manurial tests are in progress on the potato farm at Nanjanad in MADRAS. The latter tend to show that cattle and fish manures give the best results.

Of the six varieties under trial at Yawnghwe in BURMA, Ally continues to give good results in respect of yield and quality; of all the varieties tested it appears to suffer least in storage.

Scotch varieties of potatoes introduced in the Simla Hills in the PUNJAB have increased the profits of the growers by over Rs. 100 per acre. It is proposed to open a farm in the hills to meet the growing demand for seed.

PLATE VIII.

NEW VARIETIES
OF GRAM
SELECTTED AT PUSA
TYPE 5
TYPE 6
TYPE 3
TYPE 11
TYPE 25

XVII. Beans and Pulses.

Attempts made in Burma to isolate a prussic acid-free strain of the Burma bean Pebyugale (*Phaseolus lunatus*) have failed owing to the preponderating influence of seasonal conditions on the formation of the glucoside. The final effect of selection of single plants for low prussic acid content though carried on for four seasons gave negative results. Moki Lima bean imported from Japan promises to be a likely substitute for Pebyugale on the better class soils, but there is little chance of it ever replacing the latter on the poorer uplands. At Padu, Pusa 21 proved superior to all the other grams tried during the year. The area under the wilt-resistant Karachi gram increased from 22,466 to 59,361 acres.

Gram Type 4 isolated at Sabour in Bihar, is becoming very popular in South Bhagalpur. In the Central Provinces, gram Type 28 is a very satisfactory addition to the department's list of pure lines. Of the 25 strains isolated at Pusa, Types 17 and 25 are most in demand.

Breeding work on pigeon-pea is in progress at Pusa, at Sabour in Bihar and in the Central Provinces. The object in view at Pusa is the isolation of a pure line type resistant to wilt disease.

CHAPTER III.

RESEARCH AND INVESTIGATION.

In addition to the economic work on crops detailed in the previous chapter, a considerable amount of research work bearing on fundamental problems of agricultural chemistry, agricultural bacteriology, plant pathology, mycology and entomology is being done by the various Departments of Agriculture in India. Among the investigations in progress during the year may be mentioned those dealing with the movements of nitrates in the soil, the conservation of soil moisture, the fixation of nitrogen, the storage of farmyard manure, the possibility of producing artificial farmyard manure, the utilization of the sources of natural indigenous phosphate, the influence of manures on the quality of crops, the manufacture of *gur*, the detection of adulterants in *ghee*, animal nutrition and the chemistry and bacteriology of silage. Although much light has already been thrown on the problems under investigation, it is yet too early to base definite recommendations on the data collected. Some of the outstanding results are briefly noticed below; but for detailed information relating to the research and investigational work in progress, reference may be made to the Scientific Reports of the Pusa Institute and to those of the provincial research officers.

I. Soils.

Survey of soils. Soil surveys of typical tracts continue to be carried out by several departments. A soil survey of the northern taluqs of Malabar has been completed in MADRAS. The whole of the tract appears to be well supplied with nitrogen, but it is very deficient in lime and phosphoric acid, the latter being particularly deficient in coastal tracts.

In BURMA, a soil survey of the Pegu Division has revealed several exceptional soils, including one with a total phosphoric acid content of only 0·01 per cent.

A soil survey of the Saran District in BIHAR AND ORISSA has been completed and that of the Gaya District taken up. A tract

with an abnormally high percentage of phosphate in the soil has been detected west of Nawadah, whereas the farm at Nawadah itself is very deficient in phosphates.

The Scientific Staff of the INDIAN TEA ASSOCIATION has completed a survey of the soils of North Sylhet and Golaghat Division: the results have been published.

In ASSAM, a soil survey of the Jorhat sub-division is in progress. The analyses so far made reveal some characteristic changes in the composition of the soil from one river system to another.

On the completion of a soil survey of the Vaikom Taluq in TRAVANCORE, a beginning has been made with the area known as Karappuram.

Soil acidity. In ASSAM, a study of the problem of soil acidity, in conjunction with hydrogen-ion determinations, is being carried out by officers of the Indian Tea Association. The effect on a soil of air-drying has been to increase its acidity, while the reduction of acidity brought about by the addition of lime is always proportional to the quantity added. It has now become possible to estimate fairly exactly the effect of various quantities of lime on acid soils, and to state with certainty that, from the point of view of tea production, certain soils should not be limed.

Soil moisture. The physical properties of the different types of soils in the famine areas of the BOMBAY Deccan are being determined with a view to finding out the means of increasing their water-holding capacity. Two methods of increasing the retentive capacity of the soil have been devised which promise to ensure fairly good crops in years of both fair and poor rainfall.

The conservation of soil moisture is receiving attention in the PUNJAB particularly in relation to various methods of cultivation and the use of different mulches.

At PUSA, the absorption of water by soils when exposed to a moist atmosphere has been found to depend mainly on their clay content.

"Available" phosphoric acid in soil. The potassium carbonate method of estimating the amount of available phosphoric acid in soils has been found at Pusa to be suitable for the laterite soils of Bengal, the acid soils of Assam and the non-calcareous

soils of Madras, the United Provinces, the Central Provinces, Central India and the Punjab.

Movements of nitrates. A further study of the movements of nitrates in the soil and the sub-soil at PUSA, which was carried out in four areas treated as pasture, fallow, unirrigated cropped land, and cultivated land receiving irrigation, has confirmed the previous year's conclusion that the distribution of nitrates in the soil, besides being regulated by rainfall and the physical character of the sub-soil layers, is profoundly modified by the growth of crops and cultural operations. It also appears that very considerable quantities of nitrates are washed into the sub-soil and ultimately lost, and that there is only a very restricted upward movement of these sub-soil nitrates. This conclusion has been confirmed at NAGPUR after a close study of the nitrate content of the water obtained at different depths in two wells on the college farm.

II. Nitrogen Fixation.

At PUSA, the results obtained in estimating the amount of nitrogen up to a depth of one foot and of nitrates to a depth of three feet in four fallow plots, two of which got a dressing of farm-yard manure, point to the conclusion that, under certain conditions, nitrogen-fixing bacteria become very active, and add to the soil large quantities of nitrogen which is, however, readily lost unless conditions are favourable for its being nitrified and taken up by a growing crop.

Bacteriological investigations are being made at Lyallpur to throw light upon the rôle which canal water plays in maintaining the fertility of PUNJAB soils. The number of active nitrifying and nitrogen-fixing bacteria in one c. c. of canal water has been found to range from 2,200 in the winter to 121,000 in the hot months.

III. Manures and Fertilizers.

Though much of the cultivated land in India is naturally fertile, the soil over large areas has been impoverished as a result of its being cropped year after year without manure. Much of the cattle dung which should be available for manurial purposes is used as fuel, and a considerable part of the oil-seeds, wheat, rice, jute and other fibres, tobacco, etc., raised from the land is exported. Indian

soils over large areas have thus been starved for centuries; they are now hungry and therefore very responsive to manuring. Green manures, oil-cakes, bones, fish manure, nitrate of soda, sulphate of ammonia, phosphates, etc., have been tested on Government farms, and a small demand for them created by demonstrating their use in the villages. The results already obtained from these experiments indicate the great need there is of inducing the cultivator to do every thing in his power to conserve the dung of his cattle, and to supplement it by using other available manures. Some provincial departments are already giving the cultivators useful assistance and advice with respect to the use of manures.

In order to increase the supply of foodstuffs, there has been a vigorous demand in many quarters for the adoption of more intensive methods of cultivation and for the introduction of heavier yielding strains of seed; but the introduction of more prolific strains means we shall remove plant food from the soil at an increased rate. For example, our Coimbatore canes which give yields of from 50 to 100 per cent. more sugar per acre than *desi* varieties, require a proportionate amount of plant food.

Similarly by intensive cultivation the rate at which reserve plant food is brought into use is increased and stocks are thereby more rapidly depleted. The more intensive our methods of tillage and the more prolific the strains of seeds that are sown, the more imperative, in short, is the necessity for an extended and judicious use of manures.

We may, I think, take it as a fact that the soil over large areas in India is very deficient in nitrogen; our soils are to a less extent deficient in phosphate. Over small areas they are also deficient in lime. Bulky organic manures such as green manures, cattle manures and oil-cakes are particularly suitable to conditions prevailing in the country. They supply nitrogen and improve the mechanical condition of the soil, whilst concentrated chemical manures have a tendency in the opposite direction.

The best use is not at present made of cattle manure; much of the oil-seeds grown in India is exported, and a considerable part of such oil-cake as is manufactured finds its way to other countries. European countries have imposed an import duty on oil, while allowing free entry to oil-seeds and cakes. The Taxation Enquiry

Committee have in their report recommended "that as regards oil-seeds and manures an export duty should be levied, and that a part of the export duty should be applied towards educating the cultivator to make an increased use of artificial manures."

The chief phosphatic manures available in India are bones, fish manures and deposits of mineral phosphates. Much of the bones and fish manures are exported as they command a higher price in foreign markets than they do in India. As regards mineral phosphatic deposits, there is at present some doubt as to the best method of utilization.

Generally speaking, it may be said that the bulk of the manures exported at present could be used with advantage in India. They are not used because the cultivators generally do not fully realize the economic value of manuring; and, secondly, because a large percentage of them cannot afford to purchase manure. The larger landowners who could well afford to do so take little interest in practical agriculture. To create a demand for manures more intensive work should be done by departments of agriculture in testing manures on experimental farms, in demonstrating their use in the villages, in organizing their sale, and in providing credit facilities for their purchase.

In Appendix III (p. 121) will be found statements showing the quantity of different kinds of manures (*a*) exported, (*b*) imported and (*c*) produced over a period of years.

Organic manures. As the result of further work on the activation of nitrification in cattle urine, the conclusion has been reached at Pusa that the apparent toleration by nitrifying organisms of high concentrations of ammonia is actually due to the number of active organisms increasing rather than to the development of more efficient strains or to the acquisition by these of a higher degree of physiological efficiency. This superior degree of nitrifying efficiency is apparently a function of the relative concentrations of the nitrifying organisms on the one hand and of ammonium ions on the other. A paper on the application of these principles to the practical conservation of the nitrogen of cattle urine was read at the meeting of the Indian Science Congress held during the year.

Further experiments on a large scale have, at Coimbatore, proved most conclusively that the box system of storing FARMYARD

MANURE, by which the manure is compacted by the animals themselves, is the best, both from the point of view of bulk and the effect of the manure on the crop. Fortnightly weighings of animals during the course of experiments conducted over a period of three years have controverted the popular belief that the animals under this system lose condition. In the Punjab, the ordinary method of storing farmyard manure in open heaps has been found to result in losses of 16·7 per cent. of the total nitrogen, as against 11 per cent. in the case of that stored in covered pits.

The possibility of producing ARTIFICIAL FARMYARD MANURE, from straw and such waste products as groundnut husk and prickly pear, is also being investigated at Coimbatore. It appears that there is no need to employ expensive starters like " adco ", ammonium sulphate or cyanamide, as cattle urine has proved an effective starter.

Seventy-three tons of artificial farmyard manure was prepared during the year at Dacca from organic refuse such as sugarcane pith, sugarcane leaves, weeds, waste straw, etc., by using cattle urine as the starter. A quantity of bonemeal was added to bring up the phosphate content of the residue after fermentation.

Organic manure is being prepared at the Institute of Plant Industry, Indore, too, by composting weeds and organic refuse with soil, ashes (when available), and a little cowdung to start fermentation. Fresh sann-hemp composted at this institute yielded a product containing 0·97 per cent. of nitrogen, while the compost of a water weed from the local river gave about 0·5 per cent. of nitrogen. Similar investigations are in progress in Travancore.

Experiments with different leguminous plants at Pusa have confirmed the conclusion previously arrived at that higher yields are obtained by GREEN-MANURING with only the leafy portions, namely, the tops, than with whole plants. The yield of fibre obtained from the stalks remaining after removing the tops amounted to 3 cwt. per acre. In areas subject to damage from white ants manuring with tops alone has the further advantage that this pest is not provided with a tempting food supply in the shape of the woody stems of sann-hemp.

The decomposition of mustard cake has, at Pusa, been found to be speeded up by adding a quantity of charcoal equal to 5 per

cent. of the weight of cake. Not only is the value of the resultant manure increased, but the objectionable odour of the fermented cake is considerably modified.

Experiments are in progress in Bengal to ascertain the best time for the application of oil-cake and whether the rate of nitrification is affected by an application of lime. The addition of lime speeds up the action of the cake, and gives a much stronger and bigger plant.

A study of the comparative availability as plant food of the simpler decomposition products of proteins and other nitrogenous compounds found in soils has been carried out at Cawnpore. The principal conclusions are that ammonium sulphate is more effectively nitrified in Cawnpore soil than any of the amino-acids, and that the nitrogen of the compound tryptophan containing both ring and chain nitrogen is more readily nitrifiable than that of the compounds containing only chain nitrogen. The amount of nitric nitrogen in the soil fluctuates regularly, and the rise and fall of the activity of the nitrifying bacteria takes place at definite periods of the year. The nitrifying bacteria have been found to remain active in the soil even when kept in stock for more than a year.

Nitrate of soda. On an analogy with the practice obtaining in Spain the suitability of nitrate of soda as a manure for paddy is being tested at Coimbatore and Aduturai in MADRAS. Although heavy doses, both alone and in conjunction with green manures, give increased yields, the effect of the manure appears to be largely physical in character.

Calcium cyanamide. Since there is a possibility of manufacturing calcium cyanamide in large quantities by means of hydro-electric power in the MADRAS Presidency, this manure has received a good deal of attention at Coimbatore. Experiments carried out during the last three years have shown that the application of one cwt. of cyanamide in conjunction with one-and-a-half cwt. of superphosphate to paddy results in a net profit of Rs. 31 per acre. Further experiments are being laid down with a view to testing the suitability of cyanamide when applied in conjunction with green manure and farmyard manure.

Lime. It has been definitely established at DACCA that lime should not be applied to red laterite soils in large doses, but in

small frequent doses; otherwise potash, of which there is a fair quantity in the soil, is thrown out. The effect of lime is partially masked by an application of phosphate and *vice versa*.

Phosphates. Work on the utilization of the natural sulphur-oxidizing powers of certain soil bacteria for solubilization of phosphates by composting was continued at PUSA. The addition of 6 per cent. charcoal in a bonemeal-sulphur-sand compost has been found to increase very considerably the rate and extent of solubilization. In the presence of charcoal 72·6 per cent. of the phosphoric acid in bonemeal was available after 50 weeks' fermentation, while without it 39·1 per cent. only was available after 29 weeks. The most suitable amount of sulphur has been ascertained to be one-fourth of the weight of bonemeal in the compost.

Mineral requirements of different crops and varieties. The composition of the ashes of plants of different strains grown in the same soil, and of the same strain grown in different soils, is being studied at Sabour in BIHAR with a view to ascertaining (*a*) the mineral requirements of different crops and varieties, (*b*) the extent to which such requirements are supplied by different soils, (*c*) and whether there is any considerable variation in the proportion of mineral elements required by different varieties of the same crop. For instance, some strains of linseed grown at Sabour seem to remove much less phosphate per weight of crop produced than others.

Influence of manures on quality of crops A series of plots to which different manures have been applied are being cropped with a variety of cereals both at PUSA and COIMBATORE to ascertain the effect of different plant foods on the composition of the resulting produce. A number of feeding tests have been carried out by Lt.-Col. R. McCarrison with the produce obtained from the Coimbatore plots, and it is reported that wheat obtained from a plot which received cattle manure was 15 per cent. more nutritious than wheat produced in a plot manured with artificials.

The relationship between the manurial constituents of the cotton plant and the quality of cotton lint produced is being investigated at Coimbatore. It appears that the plant absorbs from the soil a very large amount of lime especially at the time when the bolls are forming.

IV. Gur.

The problem of producing *gur* superior in quality to the local dark-coloured product which deliquesces in the monsoon, is being investigated at Pusa. Experiments carried out during the year indicate that a hard, light-coloured *gur*, which neither absorbs moisture nor turns dark in course of time, can be obtained by using at the time of boiling a slight excess of lime, followed subsequently by the addition of a quantity of phosphoric acid sufficient to precipitate the excess lime. *Gur* produced from the local Hemja variety was found to be inferior to that obtained from Co. 213.

V. Adulteration of Ghee.

The detection of foreign fats in adulterated butter-fat or *ghee* is one of the most difficult problems of food analysis. This is especially so when the adulterant is an animal fat. None of the rapid tests are reliable. An investigation has, therefore, been undertaken at Pusa, with a view to discovering a successful method of detection. Of the several solvents hitherto tried, acetic ether has been found to be the most promising.

VI. Milk.

A systematic analysis of the milk of selected cows of the Pusa herd has shown a gradual rise in the fat content with the progress of the lactation period. While the fat content of the milk of pure Montgomery cows varied between 2 and 9 per cent., the variation in that of cross-bred Ayrshire-Montgomery cows was between 2·1 and 7 per cent.

Bacteriological examinations of the milk supplied from the Pusa dairy again revealed the relation between the plate counts and the season of the year.

VII. Silage.

A study of the changes occurring during the manufacture of silage under defined conditions has been completed in the Central Provinces and the results embodied in a Pusa Memoir. The main

conclusions are that no advantage is derived from sprinkling the crop with water or from withering it in the sun before it is siloed; that there is no difference in the quality of silage made in pits, whether dug in black cotton coil or in trap rock; that the silage suffers a loss of 6 to 14½ per cent. of dry matter according to the type of silo used; and that part of the crude fibre breaks down in nitrogen-free extractive. A similar investigation is in progress at Lyallpur, and the bacterial flora of silage is being studied at Pusa.

VIII. Animal Nutrition.

The work of the Physiological Chemist on animal husbandry is of particular interest, being practically the first work of its kind to be done in India. This new section has now issued the results of investigations into the nutrition of growing animals; whilst an indication is given of work now in progress on the mineral requirements of live stock, on the feeding value of Indian pasture grasses and of further work on the relative values of Indian fodders. The finding that, both at Bangalore and Karnal, Indian rice straw has a far higher food value than has previously been assumed, is of practical importance. The further discovery that its high potash content leads to diuresis in animals fed with it may also explain its present unpopularity. It has also been found that at Hosur Indian spear grass hay, even when supplemented with three pounds of concentrated food did not afford a maintenance ration for Indian cattle; but that, on the other hand, when fed on silage made from the same grass hay, the cattle showed a satisfactory gain in weight. This result is important and points a definite moral. Equally surprising was the discovery in the Karnal experiments that hay, made from the famous Indian *dhub* (*Cynodon dactylon*) grass, was less effective than rice straw; whilst the indication that wheat straw, previously supposed to be distinctly superior, is the least nutritive of the fodders tried, has an important practical bearing, as the local price of wheat straw is approximately four times that of rice straw. Of equal interest are the results from a careful series of experiments on the effect of different rations of concentrated food on the growth of young stock; the best results were obtained with a ration of comparatively low protein content.

IX. Lantana.

After a considerable number of trials in Bombay with different agents and methods, it appears that a large measure of success in eradicating lantana can be attained by the following method. The lantana bush is cut down and the stump painted with sodium arsenate. This method is reported to have given 94 per cent. of successes when tried on a large scale in jungle conditions; recutting and repainting of sprouted surviving plants with sodium arsenate completely wiped them out. Chemical analysis shows that the arsenic penetrates the plant and reaches the smaller root branches.

X. Diseases of Crops.

The practical methods adopted for combating the ravages of the diseases attacking the more important crops have been indicated in the previous chapter. It is proposed to deal here with such investigations as have not yet reached the stage of practical application.

At PUSA, further progress has been made in elucidating the factors affecting the pigeon-pea wilt problem and in interpreting the data obtained from the existing field experiments. It appears that green-manure does not always reduce loss from wilt in a plot manured with superphosphate; that under farm conditions the infection is spread mechanically through the soil in an irregular manner; that the great bulk of infection comes from the fungus in the soil and not from spores borne on the seed; and that though the amount of moisture in the soil has no direct relationship to the amount of wilt, the retentive nature of the soil increases the incidence of the disease. The wilt diseases of linseed and gram are also under study.

Considerable attention was devoted during the year to the mosaic disease of sugarcane whose presence has been reported also from the Central Provinces and Burma. The presence of leaf-mottling only has been noticed; other secondary symptoms have not yet been seen. So far infected canes do not seem appreciably smaller than healthy ones. Sets from plants having mosaic leaf-mottling have been found to give plants that have identical leaf-mottling, while juice taken from a mottled leaf and pricked

into leaves of healthy plants also produced mottling. Comparative plots have been planted with three varieties of cane to test the loss due to mosaic, and the new crop is being rogued regularly to test the possibility of eradicating the disease. It is too early to say more than that the method promises well, and so far this is the method found to be applicable in countries that have to deal with this disease.

The study at Pusa of fruit rot disease of various Cucurbitaceæ caused by a species of *Pythium* has been concluded; it has also been definitely ascertained there that the fungus responsible for deaths among young berseem plants is *Rhizoctonia Solani*.

In MADRAS, a stem-bleeding disease of areca palms has been identified as being due to the fungus which causes a similar disease of coconuts. Viable spores of *Piricularia*, which produces blast of paddy, have been found in the straw after it had been stacked for six months; this indicates how the fungus is carried over from crop to crop. Experiments to test the value of different manurial treatments in the control of *Rhizoctonia* of groundnuts gave negative results. Besides attacking cotton bolls, *Vermicularia* has been found to attack seedlings of *herbaceum* cottons. The cultural and morphological characters of the fungus show it to be a species hitherto undescribed.

Cotton wilt, cotton boll-shedding and mango flower blight are the principal subjects of investigation in BOMBAY. An attempt is being made to breed wilt-resistant non-boll-shedding types of cotton.

The results of investigations carried out in the CENTRAL PROVINCES indicate that the disease known as wilt of cotton is of physiological rather than of fungoid origin. In an observational series at Akola repeated five times over, it was observed that cotton following *juar*, though poor in growth, was less attacked by the disease than that following groundnut or cotton. The virulence of foot-rot in wheat has been found to vary inversely with the lateness of sowing. *Phytophthora* sp. has been ascertained to be the cause of heavy losses in the betel gardens of the province.

An internal boll disease of indigenous and American cottons has been discovered in BURMA. A species of *Nematospora* has been found associated with it, and the red cotton bug *Dysdercus cingu-*

latus is apparently the agent carrying the infection. The damage amounts to a hundred per cent. destruction in some cases ; American Upland types suffer more than the Burmese. Promising results have been obtained in the control of sesamum root disease by seed treatment.

XI. Insect Pests.

The measures adopted against important pests of field and garden crops have been referred to elsewhere. A large number of useful observations relating to the behaviour of injurious insects and their parasites, has been made at Pusa and in the provinces. Some of these are referred to below.

Further observations on sugarcane borers at Pusa indicate that the caterpillars hibernate in the stumps left in cane fields and that these stumps are the main source of infestation of the next crop by *Emmalocera depressella*. *Diatræa* spp. and *Scirpophaga xanthogastrella* are on the other hand to be found in the sets. Investigations have been put in hand to determine the influence of cultural operations on the pest-resisting powers of plants, and also to test the lethal effects of carbon bisulphide on *Bruchus chinensis*, a serious pest of stored grain, under varying conditions of temperature, humidity and duration of exposure. Work was continued on the life-histories and distribution of Tabanidæ.

A further study of the spotted bollworm of cotton in BOMBAY indicates that there seems to be little possibility of controlling it by the encouragement of parasites. On the other hand, the destruction of pupæ in the soil seems to be a more likely remedy. Fumigation of rat burrows with carbon bisulphide has proved very effective in checking the depredations of crabs in the Konkan and of the mole rat in Lower Sind.

In MADRAS, the paddy stem-borer (*Schœnobius*) has been found to hibernate during the hot season in the stubble and stems of wild paddy. In certain years large numbers survive to infest the new crop. Experience has shown that the moths at the time of egg-laying select a crop which has just established itself after transplantation. The study of the life-history of fruit moths was continued and tentative methods of control experimented with.

The Provincial Entomologist in the UNITED PROVINCES is concentrating on the investigation of the pink bollworm attack which is responsible for the loss of from 20 to 40 per cent. of the cotton crop of the province. An isolated area was sown during the year with seed subjected to 140° F. of dry heat. There was little sign of damage from pink bollworm and the cotton produced was of superior quality.

Researches into the bionomics and control of sugarcane borers and cotton bollworms are being continued in the PUNJAB. A study of the life-history of *Amsacta* sp., the caterpillar which does extensive damage by devouring the young plants of summer crops, has suggested the possibility of controlling it by means of light traps.

XII. Useful Insects.

Bees. The Entomological Section at Pusa continued to deal with enquiries relating to apiculture and to supply improved hives, foundation combs, etc. It appears that there is a growing demand for suitable varieties of honey bees. It will not be possible to place the bee industry on a sound footing until a well-trained apiculturist is appointed to establish strains suitable for various localities.

Lac. The Research Institute of the Indian Lac Association having begun to function, the work at PUSA is now restricted to the supply of brood-lac to the extent permitted by its limited resources.

The programme of the Lac Research Institute at Ranchi, which has a Biochemist and an Entomologist on its staff, is to obtain insight into the methods of production of crude lac, with a view to securing an increase in the yield and an improvement in the quality. Methods of maufacturing shellac are also to be investigated. The experimental plantation has been laid out with different host trees, and the optimum conditions for their growth are being investigated. A detailed study of the lac-insect and its enemies has also been put in hand. India at present enjoys practically a world-wide monopoly of the lac industry. The object before the institute, which is maintained from funds obtained by a small cess imposed on all exports of lac, is to put the industry on such a sound commercial basis that there need be no fear of competition

from a synthetic product or from the introduction into other countries of the lac insect itself.

Silk-worms. The eleven nurseries maintained in Bengal for the supply of disease-free seed of Nistari and Chotopolu races of silkworms produced 21,262 *kahans* of cocoons, as against 17,380 *kahans* in the previous year. Owing to the fall in prices consequent on the slump in the silk market, the receipts, however, dropped from Rs. 75,276 to Rs. 71,242. In addition, 13,205 *kahans* of disease-free seed were produced by selected rearers working under the supervision of the department; this seed was sold at a profit of Rs. 10,827. The propaganda work carried out in Malda and Bankura Districts has been the means of stimulating interest in the use of disease-free seed and other recommendations made by the department. Nine students passed out of the sericultural schools at Rajshahi and Berhampore, and six were paid rewards for starting model rearing houses. At the primary schools attached to the Piasbari, Amriti and Kumarpur nurseries, 80 children, all sons of professional rearers, received simple instruction in the elementary principles of improved sericulture. Grown-up sons of professional rearers were invited for the first time to work at departmental nurseries as paid apprentices; 127 youths took advantage of the offer.

In BIHAR AND ORISSA and MADRAS, the Department of Industries, which is in charge of sericultural work, is supplying disease-free seed and testing methods of reeling silk.

The Sericultural Section in Burma has been placed on a permanent footing. During the year under report, 15,215 seed cocoons and 2,570 layings of eggs were supplied to rearers. Breeding work is carried on with a view to finding out a suitable multivoltine race of worms. Some of the mongrel races produced by hybridization are very promising.

In the PUNJAB, the rearing of silkworms was extended to 128 villages, and 1,718 oz. of silk seed were distributed among 1,134 rearers. At the Government filature started at Sujanpur with a view to helping the growers to obtain a fair price for their produce, nearly half a ton of yarn was produced. Considerable progress was made in laying down mulberry plantations on waste lands along canal banks.

Chinese and Japanese bivoltine races of silkworms introduced in MYSORE are becoming acclimatized; the demand for seed indicates that the new races are popular. Over four lakhs of layings were issued from State grainages, of which over 1¼ lakhs were those of pure acclimatized foreign breeds. Moreover, 47 rearers working under departmental control produced 6½ millions of seed cocoons for distribution. The State filature devoted itself entirely to meeting the requirements of the Indian market, and sold 3,400 lb. of silk and 2,673 lb. of waste valued at Rs. 50,000. Of the 77 students under training, 22 were trained in reeling technique.

CHAPTER IV.

AGRICULTURAL ENGINEERING.

Of the 225 millions of acres under cultivation in British India, nearly 48 million acres are irrigated : more than half by Government and private canals and the rest by wells and tanks. Some splendid new canal systems are at present under construction which will irrigate several millions of acres more, but even if every scheme recommended by the Irrigation Commission is put into execution, there will still remain large tracts of the country where the limiting factor in crop production will continue to be water supply which, so far as can be seen, can only be met by developing and increasing the supply from wells by subartesian bores. This important work is being carried on but on a comparatively small scale, by the engineering sections of the Agricultural Department which have increased the capacity of thousands o existing wells and sunk an equally large number of new wells (Appendix IV, p. 123). A systematic survey of the supplies of underground water as recommended by the Board of Agriculture in 1919, is badly required.

Another important activity of the engineering sections is the designing and testing of agricultural implements. Improved ploughs have already been designed, and the introduction of types suitable both as regards cost and draught power, is proceeding (Appendix V, p. 124). It must, however, be admitted that the fringe of the scope for development in this direction is hardly yet been touched. More rapid progress can only be expected if types and their parts are standardized with a view to reducing both the cost of the implement itself and that of spare parts. The next step will be mass production which would appear to be within the bounds of possibility, now that certain engineering firms in this country have taken up the manufacture of ploughs. Mass production would lower the cost, and thereby increase the demand. The introduction of efficient types of drills, mowing machines, fodder cutters, threshers, winnowing machines and small power cane mills has not as yet received much attention.

The boring equipment in BOMBAY has been augmented to meet the growing demand for its services. Of the 206 bores put down

during the year, 116 were successful. The land development work done during the last two years under the auspices of the Agricultural Department has received such public appreciation that a separate department under a Superintending Engineer has been created for that purpose. Of the 47 schemes for field embankments prepared during the year, 17 costing Rs. 18,000 were for landowners who were able to carry them out with their own capital. The Agricultural Engineer has devised four implements suited to local conditions, *viz.*, (1) a modification of the Orient plough for Sind, (2) a seed drill, (3) a removable part for the share of the C. T. 2 plough, and (4) a winnowing machine. Arrangements are being made for their manufacture on a commercial scale.

In the UNITED PROVINCES, 62 tube wells were completed during the year. This is the highest number so far recorded. Sixty more were under construction at the close of the year. Of the 673 shallow borings made, 510 or 75 per cent. were successful.

In the PUNJAB, 284 bores were sunk during the year, of which 225 or 79 per cent. were successful. Of the 96 strainers used, 70 were of the stoneware pattern designed by the Agricultural Engineer and 20 of the old copper type. The former, while being as efficient as the latter, cost less than half. A new tube well worked by the compressed air system has been sunk on the Gurdaspur farm.

Of the 154 shallow borings made in BIHAR AND ORISSA, only 20 failed to give satisfactory results.

The Agricultural Engineer in the CENTRAL PROVINCES has designed during the year a cultivator which is on trial in Berar and a mhote wheel with ball bearings which is being tested in the plateau districts. Among the imported implements under trial are a groundnut lifter, a sann-hemp scutching machine, and a rotary hoe. The boring equipment formerly maintained by the department has been handed over to the Public Works Department.

A ridging plough, a groundnut raiser, a paddy transplanting machine, a winnower and a water elevator are among the new implements under trial in BURMA. A diaphragm pump of three-inch suction worked by one man and costing Rs. 120 has been found to give 40 gallons of water per minute at an 11 feet head.

The departmental screw water-lift is now being manufactured by several local carpenters.

The post of Agricultural Engineer in MADRAS having remained vacant throughout the year, no progress was made in designing new implements. Three hundred and forty-five wells were successfully bored by the Industries Department to whom this work is now entrusted.

Of the 106 bores sunk in the BARODA State, 71 were successful; while in HYDERABAD the respective figures were 31 and 29.

Though the different types of MOTOR TRACTORS imported into this country in recent years have not justified all that was claimed for them, they have proved very useful for shallow cultivation with disc harrows and cultivators when large areas have had to be covered. They are also useful for ploughing lands infested with obnoxious weeds. In the Central Provinces, land infested with *kans* (*Saccharum spontaneum*) has been brought under cultivation by means of tractors. In Gujarat tractors have been used on a considerable scale for preparing land for ridge cultivation. In the Punjab they have been employed for cultivating areas of land which could not have been brought under cultivation by means of animal power owing to the lack of water and food for draught cattle. Though the tractor has thus proved a farm-power unit of considerable possibilities, its use on a large scale cannot be expected until repair shops, fully stocked with spare parts, are organized and qualified drivers and mechanics trained to repair and handle both the tractor and the implements worked by it.

CHAPTER V.

DISTRICT WORK.

In the sphere of extension work the Agricultural Department has created an organization which embraces the activities of thousands of private seed farms, demonstration plots, co-operative societies, agricultural associations, etc. These are supplemented by agricultural shows, lectures illustrated by lantern slides, ploughing matches, and the distribution of popular literature dealing with improved methods of husbandry generally. That a considerable measure of success has been attained in bringing millions of acres under improved varieties of crops, will be gathered from Appendix I.

The figures for the sale of implements and parts of implements through departmental agencies are not so impressive. The sales recorded in Appendix V (p. 124) represent only a fraction of the actual number sold. A substantial private trade in these implements has grown up and in some provinces the department is gradually being relieved of this part of its extension work. During the year under report, implements of the value of Rs. 16,00,000 were imported from foreign countries. The number of agricultural implements and machines manufactured in India itself is increasing every year. Many thousands of iron cane mills are now made every year, and sold in the country. The firm of Kirloskar Bros. alone claim that they have up to date made and sold 150,000 implements and parts thereof.

The turn-over in fertilizers is similarly on the increase. During the year under report, 42,159 tons of fertilizers were imported by sea as against 7,414 tons five years ago. Similarly, manures locally available are being consumed in the country on a larger scale than formerly, and the export of bonemeal, fish guano and of oil-cakes not used for cattle food is gradually falling off. During the last ten years the sales of the principal manure firms in Calcutta and South India have almost doubled. A substantial proportion of the fertilizers sold no doubt goes to tea, rubber and coffee plantations, but larger quantities are also being applied to such valuable crops as sugarcane, cotton, tobacco and potatoes. The success

of the propaganda carried on by the British Sulphate of Ammonia Federation among the sugarcane cultivators of Western India has encouraged them to launch a similar campaign involving an annual expenditure of £20,000 in other parts of the country and to open nearly 100 depôts from which sulphate of ammonia can be obtained at a fixed standard rate.

In BOMBAY, propaganda and extension work is carried on in co-operation with taluq development associations, co-operative societies, agricultural associations and district boards. The activities of these different agencies are co-ordinated by Divisional Boards of Agriculture which are predominantly non-official in character. With the addition of 11 in the year under report, there are now 59 taluq development associations engaged in extending the use of improved implements and seed, in organizing shows and campaigns against plant diseases, in promoting the formation of non-credit co-operative societies, and in pushing forward small schemes of irrigation. The usefulness of these associations has been recognized to the extent that District Boards are coming forward to subsidize them. Among agricultural associations, the one at Dharwar has proved most helpful in acting as a central propaganda agency for the district. For the supply of seed, the department controls large areas in selected parts of the presidency. The most elaborate organization for seed distribution is in Lower Gujarat where 1,586,620 lb. of cotton seed were distributed. In the six pig-killing campaigns organized in the Deccan canal areas 273 pigs were killed. Areas bordering on the Kanara forests are protected from pigs by the erection of stone walls through co-operative societies specially formed for the purpose.

The establishment of demonstration plots on the ryots' own lands and of demonstration areas for contrasting side by side with local methods those advocated by the department is a feature of extension work in MADRAS. There were nearly 600 plots of the first kind in existence during the year and most of them met with unqualified success. This system of demonstration is much appreciated by the ryots who come forward readily in most places to offer land for the purpose of such demonstration. As in previous years, the department distributed a large quantity of improved seed. It is proposed to hand over some of the seed distribution work to well

organized co-operative societies which, through the newly organized district federations of co-operative unions, are being utilized for propaganda work. The steps taken to popularize the use of green manures for wet land achieved success, and 109 tons of different seeds were sold to cultivators. Artificial manures such as bone-meal, guano and superphosphate are also gradually coming into popular favour; one firm sold 756 tons of bonemeal in a single circle. As the result of a vigorous campaign the McGlashan *gur*-boiling furnace, which is calculated to add Rs. 90 per acre to the net profit in cane cultivation, has come into common use in many districts; in the Coimbatore District alone over 500 of these furnaces are at work.

The advantages to be gained by using improved seed and by adopting improved methods of cultivation, are being demonstrated in BENGAL by reserving a portion of each Government farm to be run on an economic basis. To supplement this work of practical demonstration, there are 100 private farms or plots established by leading zemindars and Khas Mahal and Court of Wards estates, which are cultivated on the lines recommended by the department. There was a big demand for the departmental jute seed available for sale; three times the quantity available could have been disposed of. The outstanding feature of the season was the popularity of Chinsura Green; in Nadia 4,000 cultivators formed themselves into an association to ensure supplies of seed of this departmental selection of *C. olitorius*. The jute trade has also come forward to show practical appreciation of the improved varieties of jute; the London Jute Association has granted Rs. 20,000 per annum for five years for distribution of departmental seed in tracts where it is not yet well known; while the Indian Jute Mills Association has guaranteed against loss the agent appointed by Government to sell jute seed up to a maximum of 2½ lakhs of rupees worth. The scheme for local paddy seed farms has been extended beyond the Dacca District, and there are now one or two such farms in every district.

In BIHAR AND ORISSA, in addition to the distribution of improved seed, such operations as the cultivation and ploughing in of *dhaincha* (*Sesbania aculeata*) as a green manure for paddy, the manuring of groundnut with gypsum and of potatoes with castor

cake combined with sulphate of ammonia are being demonstrated. Nearly 140 tons of gypsum and 20 tons of ammonium sulphate were sold through departmental agency. Co-operative societies, central co-operative banks and agricultural associations continued to take an active interest in the supply of seeds and manures recommended by the department. In a practical demonstration made at the instance of the Supaul Bank, the superiority of the Coimbatore canes over the local canes was so convincingly established that several other banks agreed to push on the cultivation of these canes.

There are 17 seed and demonstration farms in the UNITED PROVINCES, 16 of which are reported to have earned a profit. Interest in agriculture is said to have been stimulated by the satisfactory financial results obtained, and several persons with capital or land, or both, have come forward to open private farms and take up farming on modern lines. The number of private farms is now 621. Of the 117 new farms opened during the year, one is of 1,000 acres and is named after His Excellency the Governor who performed the opening ceremony. These farms serve not only as seed depôts but also as centres from which improved methods spread to surrounding cultivators. There was a satisfactory increase in the number of demonstrations carried out in the villages, and it is estimated that an additional area of 125,800 acres has been brought under the influence of the department. From the 127 stores run for the purpose, 3,890 tons of seed, 9,062 implements and 335 tons of manures were sold.

In the PUNJAB, three large blocks of land have been granted for the establishment of private farms on which the improved crop varieties evolved by the department are multiplied. These farms also demonstrate in a practical manner that improved methods of agriculture will give better yields and higher profits than those got by farmers in the locality. In addition, the department runs about 300 demonstration plots on land belonging to cultivators; on these plots the departmental seed is tested side by side with the local seed. There are also 30 " better farming " societies organized on co-operative lines, each of which is composed of a number of cultivators who have undertaken to farm their lands in accordance with the advice of the Agricultural Department. For the supply

of seed, there is a central depôt in each circle, with sub-depôts at convenient centres. Seed of improved varieties of wheat and cotton sufficient to sow 86,753 and 98,392 acres, respectively, were sold from these depôts during the year. From similar depôts for the sale of agricultural implements, over 14,000 implements and parts of implements were disposed of. Campaigns organized for the destruction of rats form a regular feature of the district work in this province. During the year under report, 7 million rats were killed by strychnine hydrochloride baits in an area covering over 347,000 acres; the cost of the poison worked out to 3 pies per acre. A touring cinema car has been fitted up to screen films demonstrating improved methods of agriculture; experiments are in progress to utilize wireless telephony also for propaganda purposes.

Over 6,780 tons of seed and 739,856 whole canes were distributed from 14 departmental and 6,668 private seed farms in the CENTRAL PROVINCES. Of the 5,676 implements sold, 4,262 were ploughs; the number of spare parts disposed of was 4,397. The reduction in the sale of implements through Government agency is partly due to the growth of private trade and the increased facilities now available for hiring ploughs. For example, there are 37 shops run by agricultural associations in Berar, which sell as well as hire out implements. On a capital of Rs. 65,500 they earned last year a profit of Rs. 11,710. The district staff carried out 2,405 practical demonstrations, gave 61 illustrated lectures and arranged 24 ploughing matches, while the number of agricultural shows held was 32. The policy of establishing demonstration plots is being gradually pursued. The propaganda work of the department is ably supported by non-official bodies such as agricultural associations, co-operative shops, seed associations and private demonstration farms. It is specially gratifying to note that there has been a marked improvement in the interest in agriculture taken by some of the leading *malguzars*.

Seed distribution and propaganda work is carried out in BURMA through the societies of the Co-operative Department; for certain crops, and particularly for cotton, the seed is distributed through agricultural unions. In each union there are one or more seed farms which multiply pure strains for distribution to the individual members. During the year under review, there were 340 private

seed farms and 98 unions at work. In order to provide a connecting link between the central experiment stations and these agricultural unions, a number of areas, varying from 50-100 acres, have been taken up, where seed will be multiplied under departmental supervision. Eighteen such farms have already started working in Lower Burma. Hundreds of demonstrations were conducted on small plots placed at the disposal of the department by cultivators or rented for the purpose.

Seeds, manures and implements of the value of Rs. 78,400 were sold from the three depôts in ASSAM. The most important of the articles supplied were 160 tons of potatoes, 59 tons of bonemeal and 159 sugarcane mills. A number of co-operative societies were organized during the year by agricultural officers specially for the supply of seeds, manures, etc.

Seed of Pusa 4 wheat, Red Assami cane and berseem was distributed in the NORTH-WEST FRONTIER PROVINCE as far as the resources of the Tarnab and Haripur farms would allow. The number of budded plants of improved peaches, plums apricots and pears sold was nearly 30,000.

Co-operative societies are being largely utilized in MYSORE for the distribution of *ragi* (*E. coracana*), cotton, sugarcane, and groundnut seed, commercial fertilizers such as oil-cakes and ammonium sulphate, and improved implements. The members of the Agricultural and Experimental Union are very helpful in supplementing the demonstration work carried out by the department.

In TRAVANCORE, 13,201 lb. of paddy seed, sets of different varieties of sugarcane and tapioca and selected coconut seedlings were sold to the ryots. The sales from 36 departmental and other manure depôts amounted to Rs. 15,000.

The distribution of pure seed of the long-stapled Gaorani cotton on the *takkavi* system formed the principal item of district work in the HYDERABAD State. It is estimated that nearly 2¼ lakhs of acres were grown from this pure seed.

Propaganda work in the BARODA State is devoted to the spread of 1027 A. L. F. cotton and Pusa 4 wheat; over 115 tons seed of the former was distributed in the Navasari District.

A quantity of improved seed and over 15,000 fruit trees were issued from the State nurseries in the KASHMIR State.

CHAPTER VI.

AGRICULTURAL EDUCATION.

I. Agricultural Colleges.

Agricultural education has been considered the special province of the Agricultural Department from its earliest days, and we have now three types of educational institutions, each maintained with a distinct aim. The need for agricultural colleges to train the future personnel of the department, as well as to provide education in scientific agriculture for those engaged or intending to be engaged in farming, was recognized as soon as the Agricultural Department was reconstituted in 1905. In addition to the full degree or diploma course, these colleges provide short courses of one or two years in modern agricultural methods leading up to a certificate in agriculture. There are now six such colleges at Poona, Coimbatore, Lyallpur, Nagpur, Cawnpore and Mandalay, of which the first four are affiliated to universities. The examination at Cawnpore at the conclusion of the first two years has been recognized by the Intermediate Education Board of the United Provinces, and the conversion of its final two-year diploma course into a degree course is only a question of time. At Mandalay it has not been possible to raise sufficiently the standard of admission to qualify the students for recognition as university students. Mention also must be made of the Allahabad Agricultural Institute run and financed by the American Presbyterian Mission. Two courses of intermediate college grade are given at this institute : one in agriculture and the other in dairying. The three eastern provinces of Bengal, Bihar and Orissa and Assam are at present without an institution for higher education in agriculture. The Agricultural Research Institute at Pusa and the Imperial Institute of Animal Husbandry and Dairying at Bangalore provide post-graduate courses qualifying for the highest appointments in the Agricultural Services. Some of these institutions also give short courses of a practical nature in special subjects.

The AGRICULTURAL COLLEGE AT POONA has entered upon its eighteenth year, and is reported to be as popular as ever. The

total number on the rolls was 218, including 72 freshmen, as against 184 in the previous year. The results of the university examinations were on the whole satisfactory ; out of 32 candidates for the degree of B.Ag., 25 passed.

There were 68 applicants for admission to the three-year B.Sc.Ag. degree course of the AGRICULTURAL COLLEGE AT COIMBATORE, of whom 25 were selected for admission. At the university examinations held during the year, six out of eight students passed in Part I, while 11 out of 12 qualified for the degree. The proposal to institute a special Intermediate examination in agriculture in place of the already abandoned two-year certificate course has failed to materialize.

THE AGRICULTURAL COLLEGE AT LYALLPUR provides two distinct courses, *viz.*, a four-year degree course which is subject to university rules and regulations, and a two-year leaving certificate course. There was a great rush of candidates for admission this year ; the number of applications received rose from 140 to 400. Of these, only 67 were admitted. At the annual examinations, 26 qualified for the degree of B.Sc., while out of 12 candidates only three failed to obtain the certificate. The scheme for leasing out 50 farms of 75 acres each to agricultural graduates has been sanctioned with the change that the term of the lease has been reduced from five to three years. It is hoped that at the end of the period they will not only be qualified for estate management, but will also have acquired sufficient confidence to take up farming on their own account.

Of the 128 students in residence at the AGRICULTURAL COLLEGE AT CAWNPORE, 78 were in the four-year diploma course and 50 in the two-year certificate course. In the annual examinations, 20 out of 21 students obtained the diploma, while the certificate was awarded to 12 of the 18 examined. The applications for admission rose from 131 to 158, the number of candidates for the diploma course being the highest on record.

The affiliation of the AGRICULTURAL COLLEGE AT NAGPUR to the local university caused a considerable increase in the number of applications for admission to the first year degree course. Of the 97 candidates, 51 were selected and the class ultimately settled down with 39 on the roll. Twenty-two candidates appeared at the

entrance examination for the certificate class and 11 were admitted. In the annual examinations, seven students qualified for the diploma, and 13 for the certificate.

Although all the 20 freshmen admitted in 1926 to the AGRICULTURAL COLLEGE AT MANDALAY did not pass in all subjects of the entrance examination, it is reported that they are, on the whole, better than those of the previous two years. There are now 48 students taking the 3-year diploma course, of whom only 3 are being trained at their own expense.

The two-year post-graduate course started at the Agricultural Research Institute, Pusa, on 1st November 1923, was completed during the year by Mr. Nand Lall Dutt, M. Sc., and Mr. S. Mukerji, M.Sc., in Botany and Entomology, respectively. The former, on the completion of his training, received the appointment of Second Cane-breeding Officer at the Imperial Sugarcane Station, Coimbatore. There were 28 candidates for admission to the new courses which began on 1st November, 1925. Of the six chosen by the Selection Committee, as possessing the necessary qualifications, one admitted to the Entomology course left soon after joining on receiving the offer of appointment in the Indian Museum, Calcutta. The remaining five (one each for Agricultural Chemistry, Agricultural Bacteriology and Mycology, and two for Botany), together with three admitted in the previous year (one each for Agricultural Chemistry, Botany and Mycology) and one scholar deputed by the Punjab Government for the Mycology course, were under training at the close of the year. The two post-graduate students of the Imperial Institute of Animal Husbandry and Dairying were given short courses at Pusa in estate management, cattle-breeding, plant-breeding, plant diseases, etc., during the last three months of their period of training.

The post-graduate course in animal husbandry and dairying started at the IMPERIAL INSTITUTE OF ANIMAL HUSBANDRY AND DAIRYING, BANGALORE, on 2nd January 1925, was completed by two students during the year under report. There were six applicants for admission during the third session, of whom one was selected.

The first batch of students under training for the Indian Dairy Diploma completed their two-year course in December 1925. Of

the 12 candidates appearing at the examination, nine qualified for the diploma, two passing with honours. Fifteen students of the Allahabad Agricultural Institute also presented themselves for the examination, of whom seven were declared successful. Twenty-three students out of 69 applicants have been enrolled for the new course which began at Bangalore in January 1926.

II. Agricultural Schools.

A perusal of the recommendations of the Board of Agriculture in India will show that agricultural education has been discussed by that Board time and again. As early as 1905 a resolution was passed to the effect that for rural areas a sound system of education based on rural needs was essential. In later years resolutions were passed in which stress was laid on the importance of sympathetic co-operation between the Educational and Agricultural Departments in adapting rural education to rural needs. It must be confessed, however, that as yet little has been done to give effect to these resolutions.

The village school is fundamental to any scheme of rural regeneration. The syllabus of such schools should have rural bias; it should be framed with the object of inculcating an interest in, and a love of rural life. Such schools should be supplied with suitable school readers written with the object of interesting those who use them in rural life generally; of quickening their intellectual appreciation of plant and animal life, the soil, tillage operations and the return of the seasons with their renewal of life; and with the object in particular of interesting village boys in the steps being taken by Government departments to improve economic conditions in rural areas. The need for the extension of teaching facilities of this kind is beginning to be felt; if they were provided more agriculturists would send their sons to school.

Much of the education given in primary and middle schools at present is, from the cultivator's point of view, worse than useless. It tends to alienate the sympathy of the pupil from the land, and to unfit him for farming as a vocation. Demand for and appreciation of education of this type is, and always will be small as far as the best cultivating classes are concerned; they want something more practical.

The guidance of young minds to rural ideals depends much more on the personality of the teacher than on furniture and equipment. It is with the teacher that reform of rural education should therefore start. A rural policy should aim, in short, at discovering and developing a " country sense " in teachers ; they should be drawn, as far as possible, from agricultural classes and be specially trained.

I have in previous reports given my opinion regarding the merits of the two systems of agricultural education now under trial in rural schools. It would appear that special agricultural schools of the " Loni" type are never likely to be popular ; they are very expensive and have not as yet appealed to the people in those provinces in which they have been tried. Any demand which at present exists for agricultural training of a vocational type given at these special schools could probably be met more effectively by providing special courses at agricultural colleges.

In the Punjab, agriculture has been added to the curriculum of ordinary vernacular middle schools with the object of giving the boys who attend them a bias towards farming as an occupation. This is the most one can hope to do when dealing with mere youngsters. These "bias" schools would appear to have great possibilities. They aim at giving the boys such an outlook on rural life as will induce them to return to the land with minds better prepared to receive agricultural training and with interest aroused in agriculture and its possibilities.

There were 191 students on the rolls of the six agricultural vocational schools in the BOMBAY PRESIDENCY in the year under review. These schools provide a vernacular course of two years in practical agriculture. There are 2 vocational schools in the MADRAS PRESIDENCY and there is a proposal to open a third. In spite of wide advertisement and the offer of a stipend of Rs. 10 per month the number of *bonâ fide* students at the Dacca agricultural school in BENGAL has shown no tendency to increase. Forty-nine students were under training at the Bulandshahr school in the UNITED PROVINCES. Like the special vocational schools in Bombay Presidency, this school is being used to some extent as a training centre for the teachers being trained for work in vernacular middle

schools in which agriculture is to be added to the curriculum as has been done in the Punjab.

No vocational agricultural school has been opened in the PUNJAB, but ordinary vernacular middle schools in rural areas are being utilized for imparting a practical training in agriculture. The special features of the scheme are that a small farm or plot is attached to the school, and that an elementary training in agriculture is given in the higher classes by a teacher specially selected for the work and trained for a year at the Agricultural College at Lyallpur. Some of these school farms and gardens are not only self-supporting but show an annual balance at their credit; moreover, they are becoming useful propaganda centres. The Punjab Government deserves credit for taking the lead in adapting education in rural areas to rural needs by means of these schools. In the Bombay Presidency too, an effort is being made to give education an agricultural bias by following the Punjab model. There are now 63 "bias" schools in the presidency; the number is to be increased as fast as teachers trained for the work are available.

The Powarkhera agricultural school in the CENTRAL PROVINCES, which was started as a vocational school, has been converted into an ordinary anglo-vernacular middle school with agriculture as one of the subjects provided for in the curriculum. It has thus been brought into line with the "bias" schools of the Punjab. There were 36 students under training at this school in the year under report, and a big increase in that number is expected as a result of the changes made in the curriculum.

The agricultural school at Pathra (Godda) in BIHAR AND ORISSA, the missionary management of which receives a monthly subsidy, had 40 students under training during the year under report. It has been decided to start as an experimental measure a model garden in a middle English school in each of the five Revenue Divisions. The Agricultural Department has guaranteed to bring these gardens to a state of efficiency for the purpose of illustrating the best practice that the department can recommend in the locality, while the Education Department will see that the work of the school curriculum is co-ordinated with that in the garden.

The fourth year of the subsidized agricultural school at Pyinmana in BURMA, which is managed by the American Baptist Mis-

sion, opened with 64 students, of whom 18 were in the final class. The educational standard of those entering the school is stated to improve from year to year.

The Hebbal and Chikkanhalli schools in MYSORE had 34 and 17 students respectively. Of the five students in the final class at Hebbal, three were considered good enough for a diploma and two left with a certificate. At the other school, 14 appeared at the examination, and 12 were declared successful. With a view to providing more facilities for a vocational course as given at Chikkanhalli, proposals are under consideration for establishing two more such schools at Marthur and Nagenhalli.

The second batch of students admitted to the Alwaye school in TRAVANCORE completed their course during the year. An area of 300 acres has been assigned by the State for allotment of a ten-acre plot to each boy trained at the school, who will cultivate it on lines approved by the Agricultural Department. Besides the land, he will also get an advance of Rs. 250 for the purchase of seeds, manures and implements.

III. Short Courses.

A special class of 22 officers of the Co-operative Departments of the Punjab, United Provinces, Bengal, Bombay, Baroda State and Cochin State was held at BANGALORE for a three-month course in co-operative dairying. In addition to these, 16 short-course students from different provinces, and 24 veterinary assistants deputed by the Punjab Government received technical instruction in cattle-breeding and dairying at Bangalore and Karnal.

At PUSA, seven students, including four scholars of the Indian Central Cotton Committee, took a short course in entomology.

The six months' practical vernacular course at LYALLPUR was taken advantage of by 21 students, of whom 18 passed in the examination. The rural economy class, which lasts for a month was attended by 14 officers of other departments, while 30 senior vernacular teachers qualified themselves for the teaching of agriculture in rural middle schools. With a view to training village blacksmiths to repair oil-engines and modern implements, a six-week course is being given at the agricultural workshop. The six-month vernacular course on the Gurdaspur farm was

attended by 33 students, of whom 29 passed in the final examination.

The classes for juvenile and adult labourers at the agricultural stations at Coimbatore, Palur and Anakapalli in MADRAS continued to work satisfactorily. A boy from one of these schools is now a teacher in a village school.

Three Kamdars sent by the Co-operative Department for the Sambalpur Co-operative Bank were given a course in improved methods of agriculture for a period of nine months on the Kanke farm in BIHAR. An employee of the Sankara Wards Estate was also trained on the Banka farm.

In BURMA, short courses extending from a week to three months were given to 146 adult farmers at the principal central farms. Arrangements have also been made to give a course in horticulture at Hmawbi to 10 students every year.

In ASSAM, 15 fresh apprentices have been admitted to different farms of the province for training as demonstrators.

CHAPTER VII.

THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE.

All the world over, but few small farmers can finance their operations without recourse to credit, and the Indian peasant is no exception to the rule. It was the mercilessness with which the professional moneylender exploited the cultivators' necessity, that was the chief factor in inducing the Government to initiate the co-operative movement in 1904. During this period of 22 years, considerable progress has no doubt been made in providing better credit facilities, but these organizations could still further increase their influence for good among the cultivators by extending their activities in other directions. For instance, the propaganda work of the Agricultural Department could, with advantage, be carried out on a much larger scale, than is being done at present, through organized bodies of co-operators. In recent years the relations between the Agricultural and Co-operative Departments have become increasingly close and the latter has begun to interest itself in the spread of pure seed, improved implements and manures, but a still closer liaison requires to be established if the cultivator is to profit fully by the improvements evolved for his benefit on the research stations of the Agricultural Department. An organization for the marketing of agricultural produce and for the supply of agricultural requisites on a co-operative basis, is no less necessary than agricultural credit, but little has yet been done in this direction (Appendix VII, p. 128). It is by combining the two functions of money-lender and trader that the Indian *sowcar* has acquired such a hold on the agricultural population of the country, and until both functions are taken over by the Co-operative Movement, agricultural depression will not be materially relieved. The success of cotton sale societies in Bombay, of milk societies in Bengal and of commission sale shops in the Punjab has opened up a vista of great possibilities in this direction, but to accelerate the progress the organization of non-credit forms of agricultural co-operation should be a definite branch of co-operative work entrusted to officers

specially selected and specially trained for the purpose. The following facts and figures culled from the provincial reports will give an idea of the development of co-operation in different directions.

Bombay. The number of agricultural societies of different types went up to 3,868, an increase of 491, as against 327 and 181 in the previous two years. The membership increased from 243,000 to 271,000, while with a rise of 26 per cent. the working capital stood at Rs. 314 lakhs. The number of non-credit societies increased from 223 to 253. Of these, the most important are 31 sale societies. Manures of the value of Rs. 55,000 were sold by 17 societies organized for the purpose. In addition, a large quantity valued at over eight lakhs of rupees passed through the shops of the Provincial Co-operative Bank in the canal tracts. The 69 societies for the sale of machinery and implements include three power pumping societies in Gujarat. Of the 10 seed societies in Sind, the one at Malir purchased potato seed to the extent of Rs. 33,000 and made a profit of Rs. 5,400. The cattle-breeding and fencing societies now number 18 and 11 respectively.

Madras. With an increase of 568 societies during the year, the number of agricultural credit societies stood at 9,822. The membership rose from 487,431 to 523,564, and the working capital from Rs. 358 lakhs to Rs. 398 lakhs. Of the 98 societies devoted to purchase and sale, 52 earned a net divisible profit of Rs. 10,536; and 42 (excluding four societies not started before the end of the year) sustained a loss of Rs. 58,561 on the year's working. Four out of five societies for production and sale worked at a profit. Among the 250 other non-credit societies, those in Tanjore and South Arcot did very useful work in clearing silt from, and closing breaches in the irrigation channels; in regulating the water supply, and improving drainage. The seven land reclamation societies in Tanjore and Trichinopoly Districts completely cleared 315 acres of arable land, of sand deposited during the floods of 1924. The financial success of the agricultural demonstration society at Lalgudi has led to the registration of four new societies of this type. The Bodinayakanur Cardamom Planters' Credit Society made a joint sale of their produce, and, on a turn-over of nearly 13 lakhs of rupees, earned a profit of Rs. 3 lakhs.

Bengal. The number of agricultural credit societies rose from 9,835 to 11,169, the membership from 246,043 to 280,503, and the working capital from Rs. 2,13,81,661to Rs. 2,56,53,753. Satisfactory progress has been made in the development of other forms of co-operation also; societies for agricultural purchase and sale now number 53 as against 22 two years ago; while irrigation societies have increased from 173 to 350 in the same period. Of the latter, 170 are in Bankura and 168 in Birbhum; these control in the aggregate a total area of 25,000 acres. Of the 21 co-operative agricultural associations started to run model farms on commercial principles, the biggest are at Chaudanga and Naogaon with a membership of over 4,000 and 3,359 respectively. Very little has yet been done by most of these associations towards the attainment of their object.

Bihar and Orissa. The number of agricultural societies rose from 5,862 to 6,608, the membership from 159,798 to 177,136, and the working capital from Rs. 1,38,82,866 to Rs. 1,62,32,292. Seven of the eight purchase-and-sale societies worked more satisfactorily than in the previous year, but the 21 societies devoted to production and sale have proved incapable of improvement, and are considered fit for gradual liquidation. The Bihar Central Bank, however, successfully organized the sale of potatoes on a co-operative basis; on an investment of Rs. 36,000, a profit of Rs. 8,500 was earned, of which Rs. 6,500 were paid to the producers as bonus. The number of working grain *golas* (stores) increased from 79 to 84; these afford relief to the members in the shape of loans at very low rates of interest; they provide, too, a reserve stock of grain for use during years of scarcity.

United Provinces. The number of agricultural societies rose from 5,678 to 5,899, the membership from 140,476 to 144,384, and the working capital from Rs. 82,84,852 to Rs. 88,42,305. Of the six non-credit societies in existence at the beginning of the year, three have already been cancelled and two more will have to be closed down soon. The two central agricultural supply societies are, however, flourishing; they made a profit of Rs. 3,999 on a capital of Rs. 32,714. A start has been made in the consolidation of holdings by the registration of one society in the Saharanpur District.

Punjab. The number of agricultural societies increased from 11,408 to 12,617, the membership from 305,151 to 344,731, and the working capital from Rs. 3,60,99,639 to Rs. 4,38,85,128. The nine mortgage banks at work during the year redeemed 3,372 acres of land at a cost of Rs. 4,32,000. Societies for consolidating holdings now number 237 with 10,928 members. The 67 new societies registered during the year covered an area of 18,414 acres, in which 32,059 blocks were, by distribution, reduced to 6,108 and the average size of a block was raised from 0·6 to 3 acres. Immediately on redistribution, 1,300 acres have been brought under well irrigation and 4,632 acres of waste land broken up. The 23 societies for silt clearance continue to do valuable work. At the close of the year there were 123 societies for cattle-breeding and 6 for sheep-breeding, as against 43 and 5 respectively in the previous year. The former had 2,516 members who maintained 2,707 approved cows. A beginning has also been made in co-operative milk recording by the registration of 13 societies with 400 cows. The Punjab Co-operative Union, with the aid of a Government grant, has appointed six recorders, and supplied several Sandringham recording machines. The number of better-farming societies increased from 18 to 55; the members, who number 7,221, have agreed to cultivate their lands on improved lines as laid down by the Agricultural Department. Thirteen commission sale shops were at work during the year; they sold produce worth Rs. 25 lakhs. The majority of the 41 agricultural supply unions have failed to prosper, and some are about to be closed down.

Central Provinces. Increased caution in the registration of new societies and more prompt liquidation of bad ones combined to reduce the number of agricultural credit societies from 4,142 to 4,071 and their membership from 61,736 to 60,439. The working capital of Rs. 1,55,90,729, however, showed an increase of over 20 lakhs of rupees. There are 66 credit societies in the Sihora tahsil which carry on a seed business besides the usual loan transactions. Non-credit agricultural societies are now mainly confined to Berar. The number of agricultural unions organized for the production and distribution of cotton seed has dwindled to 9, seven dormant ones having been cancelled. Of the eight agricultural associations for the sale and hire of implements, only two worked

at a profit. It has been found necessary to reorganize the Akola commission shop on the lines of the cotton sale societies in Bombay.

Burma. The process of weeding out unsatisfactory societies was continued; the number of agricultural credit societies declined from 4,172 to 4,032, and their membership from 95,405 to 91,369; but the working capital of Rs. 2,17,82,724 exceeded that of the previous year by nearly 13 lakhs of rupees. Non-credit agricultural societies have similarly been reduced from 99 to 89. Very few of the 21 societies for purchase and sale did any business; those which did, suffered loss. A large majority of the 62 societies for production and sale are in an equally bad way; while the six societies for production (irrigation and embankment) only exist on paper.

Assam. The number of agricultural credit societies rose from 761 to 883, the membership from 32,566 to 36,927, and the working capital from Rs. 12,03,875 to Rs. 15,30,443. There are no non-credit agricultural societies in this province. Since the close of the year a co-operative land mortgage bank has been established in the district of Kamrup.

Delhi. With an increase of 30 during the year, there are now 199 agricultural credit societies; the membership similarly rose from 3,302 to 3,813 and the working capital from Rs. 3,67,498 to Rs. 4,80,503.

Co-operative Cotton Sale Societies.

During the year under report, the value of cotton sold by co-operative cotton sale societies in the Bombay Presidency amounted to Rs. 62½ lakhs as against Rs. 46 lakhs in the previous year. The increase in value is all the more remarkable in view of the fact that the yields in the fields were comparatively poor and the prices prevailing low. A noteworthy event was the boycott by the local brokers of the Gadag society. The brokers were not satisfied merely with their own combination to boycott the society; they tried to organize all the ginning and pressing factories, seed merchants, cartmen, coolies, etc., against it. In spite of this, the boycott failed, mainly because the cultivators and one Parsee broker stood loyally by the society; the former sent proportionately larger quantities of cotton than ever before and the latter purchased practically all that was offered for sale. It is estimated that about

one-sixth of the total cotton brought to the market passed through the society. The cotton sale societies in Gujarat, which sold cotton worth Rs. 14 lakhs, are distinguished from those in other parts of the presidency in that they sell only members' cotton, and no one is admitted as a member who does not use the improved seed distributed by the societies. A federation of these societies has been formed which holds regular meetings, and though no action has as yet been taken for joint sale, opinion is tending in that direction. The movement has spread to the neighbouring territory of the Baroda State, where five cotton sale societies were formed during the year.

Co-operative Milk Societies.

In the BOMBAY PRESIDENCY, there are six dairy societies with 209 cows and buffaloes. They sold milk to the value of Rs. 41,000. The number of milk societies in BENGAL increased from 63 to 74; 71 of these are affiliated to the Co-operative Milk Union in Calcutta. The latter earned a profit of Rs. 14,508 on sales of Rs. 1,62,950. Sixty-four of the affiliated societies have achieved financial independence; they were also able to deposit in the Milk Union Rs. 20,199 out of their surplus funds. In the CENTRAL PROVINCES, the *gaoli* society at Telinkheri near Nagpur handled over 447,000 lb. of milk and made a profit of Rs. 10,222, as against Rs. 7,138 in the previous year. Of the three dairies in the UNITED PROVINCES, the one at Allahabad only is doing useful work; the other two at Benares and Lucknow have been in a moribund condition for a long time. The dairy society at Mayaganj in BIHAR AND ORISSA is running at a profit.

Cattle Insurance.

Cattle insurance societies in Burma are reported to be gradually deteriorating; the number of societies dwindled from 397 to 395, the amount of risk insured from Rs. 56,304 to Rs. 36,125, and the premia collected from Rs. 1,604 to Rs. 1,438. There are no insurance societies left in the Punjab and the United Provinces, and only one of the nine societies on paper in Bombay was able to collect premia. Three new societies with 41 members started in Madras during the year did no business.

CHAPTER VIII.

LIVE STOCK.

I. Prevention and Treatment of Disease.

Rinderpest which broke out in an intense form in the latter half of 1924 after a comparative respite of over three years raged throughout the year under review in all major provinces, except Bihar and Orissa, with an almost unprecedented virulence. The reported mortality from contagious diseases consequently rose to the record figure of 399,845. The 277,931 deaths from rinderpest itself were higher than the total mortality for the previous year by 11,454. The provinces which suffered most severely were the Punjab, Burma, the Central Provinces and Assam which lost through rinderpest 52,269, 44,583, 38,685 and 31,799 cattle, as against 31,750, 14,081, 22,475 and 12,541, respectively, in the previous year. Each of the other major provinces, except Bihar and Orissa, recorded more than 20,000 deaths from this disease, and even the latter lost over 10,000 cattle.

The calls made on the services of the veterinary staff were unusually numerous, and it redounds to its credit that it rose to the occasion and carried out 1,550,199 preventive inoculations which were higher than those of the previous year by 581,768. Many outbreaks remained unattended, but this was inevitable, for the system of reporting outbreaks is far from perfect. Moreover, it is not possible to attend to all reported cases even, for the increase in the staff of the department has not been commensurate with the growing confidence of the Indian ryot in the prophylactic measures employed by the department. A careful study of statistics indicates that what we have to expect is a three-year period of depression followed by a similar period of recrudescence of rinderpest in India. How much preventible loss in the cattle wealth of India occurs in the absence of adequate staff can well be imagined from the fact that while 91,300 bovines were protected in 800 outbreaks of rinderpest in Bombay, no inoculation could be carried out in 582 outbreaks.

The number of hospitals and dispensaries maintained for treatment of disease rose from 683 to 720, and the cases treated therein from 1,582,418 to 1,742,048. In addition, 1,097,640 cases were treated by itinerant veterinary officers. The total number of 2,839,688 cases treated shows an improvement of almost 50 per cent. over the figure for 1921-22.

Of the 282,826 bulls offered for castration during the year, 182,998 were from the Punjab. It is a pity that in spite of the introduction of the Burdizzo castrator, by which an animal can be rendered sterile without injuring the religious susceptibilities of the owners, there should be, outside this one province, such reluctance to getting scrub bulls emasculated. In British India there are 1,120,000 bulls to 9,022,000 cows; 225,000 good bulls if stationed at convenient centres should be sufficient. Hundreds of thousands of inferior bulls are left to propagate their kind and thereby retard progress in the improvement of cattle by selective breeding as recommended by the Department of Agriculture.

II. Incidence of Disease.

Bombay. Rinderpest prevailed in almost all districts continuously throughout the year and carried away 23,645 animals. Anthrax was not so widespread as in the previous year and accounted for only 478 deaths.

Madras. There has been a sharp rise in the mortality from rinderpest during the last three years, the figures being 3,434, 9,681 and 23,724. The other diseases prevalent on some scale were hæmorrhagic septicæmia and anthrax which were responsible for 4,779 and 4,087 deaths, respectively.

Bengal. The total mortality of 33,224 was the highest for the last quinquennium. Both rinderpest and hæmorrhagic septicæmia were more virulent than in the previous year, and accounted for 24,695 and 5,971 deaths, respectively.

Bihar and Orissa. Compared with the neighbouring provinces of Bengal and United Provinces, cattle in Bihar had a healthy year, and the total reported mortality of 16,449 was the lowest in the last quinquennium.

United Provinces. Deaths from rinderpest were three times as high as in the previous year, and this contributed to the increase

in the total mortality reported from 18,050 to 40,738. Surra appeared in epidemic form in several districts and carried away 787 equines.

Punjab. As in other provinces, rinderpest was particularly rife this year, and 52,269 animals, as against 30,469 in the previous year, succumbed to this fell disease. Surra was also more prevalent, but not a single case of dourine was reported.

Burma. Rinderpest was responsible for the increase in the total number of deaths reported, namely, 49,789, as against 18,555 for the previous year: 44,585 deaths were due to rinderpest alone, as compared with only 14,081 in 1924-25. Deaths reported from surra numbered 208.

Central Provinces. Deaths from rinderpest rose from 22,475 to 38,685; the total mortality for the year was three times that of 1923-24 and six times that of 1922-23.

Assam. Out of 56,627 deaths reported in Assam, 31,799 were from rinderpest. The latter figure is almost three times that for 1924-25.

North-West Frontier Province. With an increase in the incidence of rinderpest, the total mortality increased from 1,978 to 3,579. There were 31 reported cases of surra, but not a single one of dourine.

Sind. There was a drop in the mortality from rinderpest and pleuro-pneumonia: the total mortality of 2,943 was only half that of the previous year.

Baluchistan. The total number of deaths reported was 5,572, as against 2,483 in the previous year; anthrax alone was responsible for 4,344 deaths.

Rajputana. The mortality from contagious diseases dropped from 1,060 to 718 owing mainly to the lesser incidence of rinderpest.

III. Preventive Inoculation.

With the prevalence of rinderpest in an intense form throughout the country there was a record demand for the products of the Imperial Veterinary Research Institute at Muktesar, and the issue of sera and vaccines rose from 3,535,699 doses in 1924-25 to 6,181,800 doses during the year. How unprecedented this demand

was will be gauged from the following table comparing the doses issued during 1925-26 with the average of the previous five years.

	1925-26	Average of previous 5 years
Rinderpest serum	5,295,829	2,565,760
Anthrax serum	73,018	35,390
Hæmorrhagic septicæmia serum	402,953	202,236
Hæmorrhagic septicæmia vaccine	211,150	180,910
Blackquarter vaccine	21,500	38,143
Mallein	64,936	53,430

That the Muktesar Institute was able not only to meet such an extraordinary demand for rinderpest serum promptly and completely, but also to prepare nearly 20 lakhs of extra doses was mainly due to the full use made of the resources of the Izatnagar Branch Laboratory near Bareilly. Until it is possible to take effective steps to give permanent immunity to all cattle against rinderpest, this scourge is likely to have a triennial recrudescence of virulence, and this year's experience should be taken as a guarantee of the ability of the institute to cope with all abnormal demands for serum in the future.

Almost all the five million doses of rinderpest serum issued during the year were used by the serum-alone method. The serum thus administered confers immunity upon an animal exposed to infection, for a period sufficiently long to carry it through an outbreak. Its efficiency has been proved again and again and has impressed even the sceptic Burmese peasant. Thus writes the Deputy Commissioner of Sagaing :—" It is gratifying to note that no opposition was offered to inoculation anywhere. The villagers generally appreciate the value of inoculation and they readily come forward to have their cattle inoculated by the Veterinary Assistants."

Permanent immunity against rinderpest can be conferred by the serum-simultaneous method, in which cattle are inoculated simultaneously with an adequate dose of protective serum and a very small quantity of blood withdrawn from an animal at the height of the disease. The simultaneous method was tried this

year on a large scale for the first time in the Mysore State. As many as 37,500 cattle were inoculated, of which only 20 succumbed to the after-effects.

Hæmorrhagic septicæmia comes next in importance to rinderpest. It is prevalent particularly during the monsoon months. The potent serum issued from Muktesar was used for protecting 248,000 bovines during the year. The immunity conferred is, however, short-lived. A more lasting immunity can be set up by administering beforehand a vaccine to animals in low-lying villages liable to visitations of this disease. Of the 147,753 thus protected in the Punjab during the year, only two were reported to have died.

Anthrax and blackquarter are the other contagious diseases against which preventive inoculation is done on a large scale. Results of inoculations made during the year show that the mortality among treated animals is as low as 0·02 and 0·06 per cent. respectively. A large quantity of the new, safe and efficacious blackquarter vaccine known as aggression was made towards the end of the year, and there has already been a considerable demand for it.

IV. Veterinary Education.

For the training of students in veterinary science, there are colleges at Bombay, Madras, Calcutta and Lahore, and schools at Insein and Taunggyi in Burma. With the conversion of the Insein school into a college and the establishment of the college sanctioned for Bihar and Orissa, the United Provinces and the Central Provinces will be the two major provinces left without an institution for higher veterinary training. The Bihar college will have a cattle-breeding and dairy farm attached to it, where the students will get practical instruction in animal husbandry and dairying. The colleges at Bombay, Madras and Calcutta give a 3-year diploma course in English, while that at Lahore provides a 4-year course. The institutions at Madras and Lahore also conduct post-diploma classes for selected subordinate officers of the department. The number of students who passed the diploma examinations of the colleges declined from 94 in 1924-25 to 50 in the year under report. The reduction is shared by all colleges,

and is to be attributed to the shortage of openings in Government service.

The veterinary schools at Insein and Taunggyi in Burma continued to impart instruction in the vernacular in a 3-year and 1½-year course, respectively. Thirteen passed the final examination at Insein as against 15 in the preceding year; while two students passed out of the Taunggyi school. As the standard of admission to the new Insein college has not been fixed, fresh pupils have not been admitted during the last two years. Good progress has been made with the new college building.

At the Imperial Institute of Veterinary Research, Muktesar, one officer of the Madras Veterinary Department completed a post-graduate course, and one officer of the Royal Army Veterinary Corps and six subordinates took short courses in laboratory methods. Three subordinate officers of the Mysore Veterinary Department are also undergoing at this institute a special course extending over three years.

Sixteen farriers were trained at Lahore, while at Calcutta two courses of lectures and demonstrations on infectious diseases of animals were given to students undergoing training as sanitary inspectors. Eleven students passed out during the year from the veterinary compounders' class attached to the Nagpur hospital.

V. Veterinary Research.

The Imperial Veterinary Research Institute at Muktesar was short-handed in its superior staff during the year under review, and the extraordinary demands for the routine products absorbed very largely the time and energies of the available staff. Nevertheless, research results of some importance to the welfare of the live stock in the country were achieved. Some of them are mentioned below.

Rinderpest. Experiments to test the duration of immunity resulting from the active immunization of cattle by the serum-simultaneous method, were continued. Information was also collected concerning the periods during which serum-producers are capable of yielding potent anti-serum and the gradation in potency of the serum during the period of profitable yield. The

investigation into the possible transmission of rinderpest through the agency of the tick *Boophilus australis* gave negative results.

Hæmorrhagic septicæmia. Information obtained as the result of further investigation into the factors that govern the maintenance of antigenic properties in the virus of this disease has helped to reduce the programme of serum manufacture to very simple terms.

Blackquarter. It has been ascertained that the organism commonly responsible for outbreaks of blackquarter among cattle in India is *Bacillus chauvœi,* while the so-called malignant œdema types, notably *Vibrion septique,* are frequently responsible for sporadic cases.

Contagious bovine abortion. A serological study of numerous herds in which this disease has appeared with virulence and of the causal organisms isolated from morbid material, has thrown considerable light on the possibility of achieving curative results through vaccination.

Coccidiosis and Piroplasmosis. The resuscitation of the parasites of these diseases in the animals harbouring them, especially of *Piroplasma bigeminum,* during an attack of rinderpest, is under investigation at Muktesar.

Johne's disease. An experiment designed to give cattle permanent immunity against this disease by vaccinating them with an avian strain of tubercle bacilli proved a disastrous failure at Bangalore.

Surra. Progress was made during the year in the treatment of surra with the German product known as Bayer 205, which has already been a conspicuous success in the treatment of the similar human affection known in Africa as sleeping sickness.

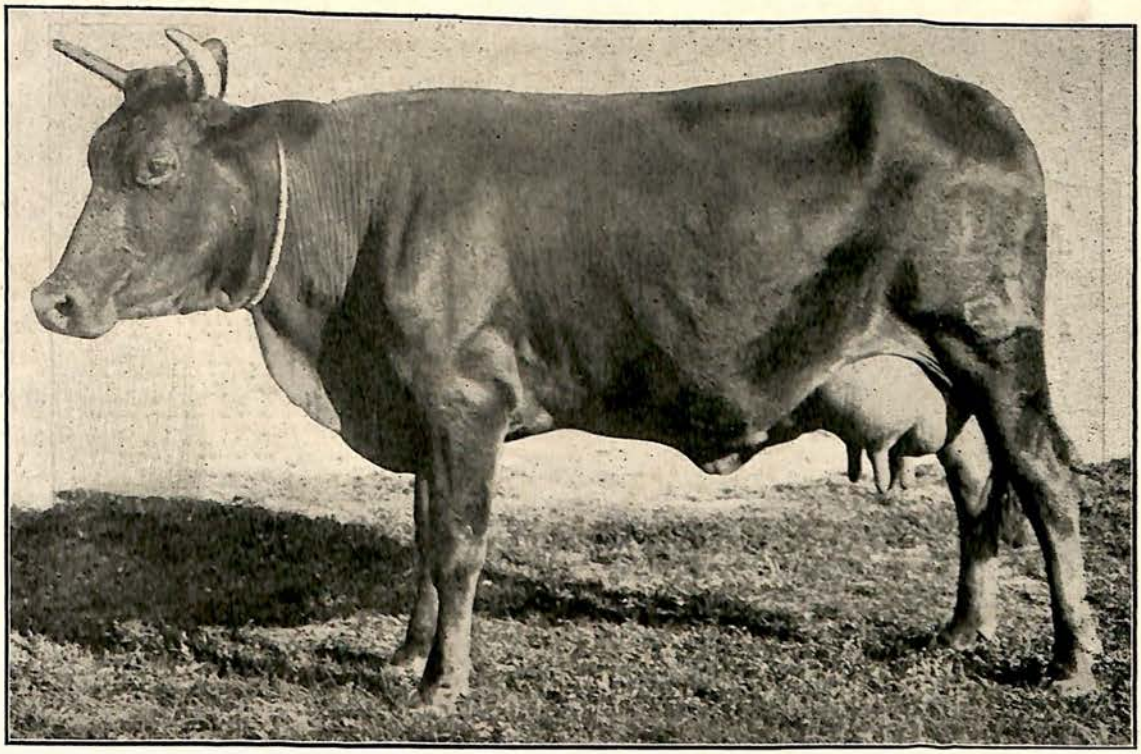
Foot-and-mouth disease. From the experiments carried out at the Punjab Veterinary College the conclusion is warranted that cattle infected with foot-and-mouth disease can be cured in the febrile stage by the intravenous injection of Lugol's solution of iodine. The treated animals show no obvious lesions of foot-and-mouth disease, their general health is little affected and there is no appreciable loss in weight and condition. Iodine is very rapidly eliminated from the system and the amount administered is so small as not to have any harmful effect on flesh or milk.

Seasonal diarrhœa. Success has been attained in the Central Provinces in the treatment of the condition in cattle commonly classified as seasonal diarrhœa, by the administration of potassium permanganate tablets made up by a local firm according to specification.

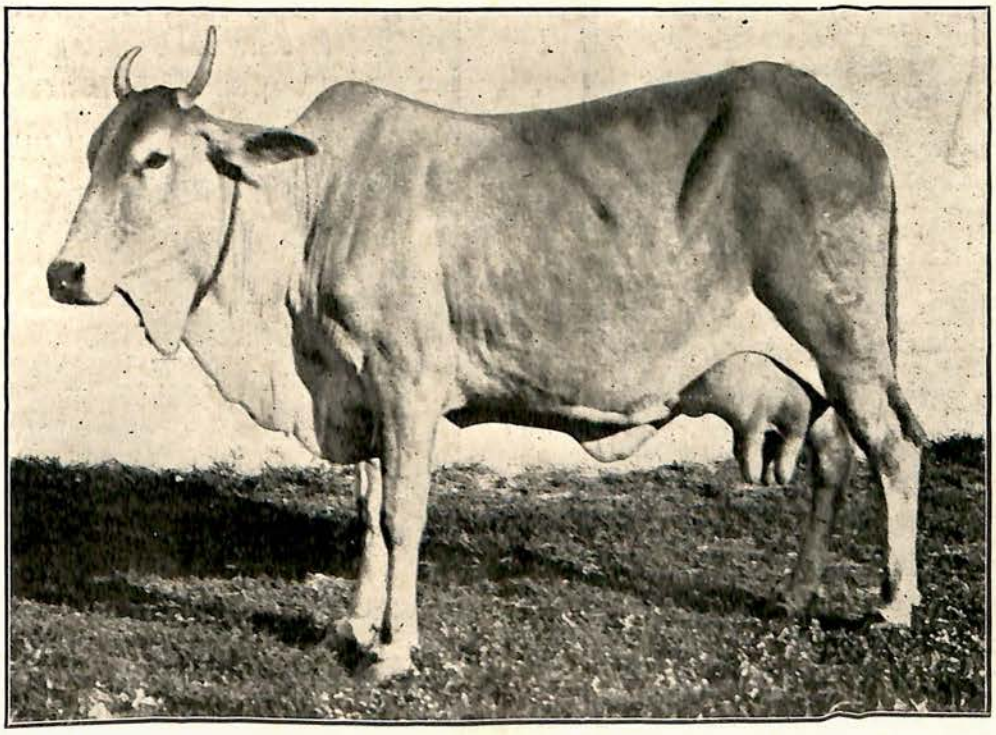
VI. Breeding.

Cattle-breeding. It appears from the report of the second census of live stock held in 1924-25, that there are nearly 151 millions of cattle in British India, and that there has been an increase of 3·5 per cent. during the last five years. If numbers only count, India should be considered rich in her cattle wealth, but unfortunately there are too many scrub half-starved cattle in this country, and the efficiency of both males and females is very low. Cattle-breeding farms on which herds of the principal breeds are being improved by selection, cross-breeding and better feeding have been established in every province, and new fodder crops are being brought to the notice of the people interested in cattle rearing. Methods of storing fodder both as silage and in the dry state are also being demonstrated. Information regarding the digestibility and nutritive values of different fodders is being collected at the Institute of Animal Husbandry and Dairying, Bangalore, where facilities for a thorough training in the theory and practice of animal husbandry and dairying have been provided. In Bengal, the Co-operative Department has organized in Calcutta the sale of milk produced in villages in surrounding districts. In the United Provinces, two private schemes have been promoted for the supply of milk to the cities of Agra and Hathras. Similarly, milk is daily transported from Pusa to Muzaffarpur, a distance of 22 miles, where it finds a ready market.

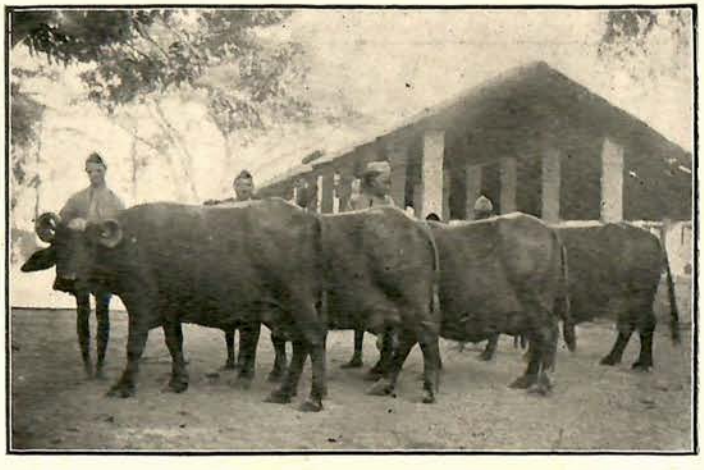
With a view to stimulating and to some extent co-ordinating the efforts being made in the various provinces and Indian States towards cattle improvement, the Government of India have established a Central Cattle Bureau at Bangalore with the Imperial Dairy Expert as Secretary. The question of vesting the control of the Bureau in an expert executive committee nominated by the various Provincial Governments, the larger Indian States and cattle-breeding interests, as recommended by the Board of Agri-



Half-bred Ayrshire-Sahiwal cow Laura No. 98, Pusa. Gave 9,817 lb. of milk in 10 months in the second lactation.

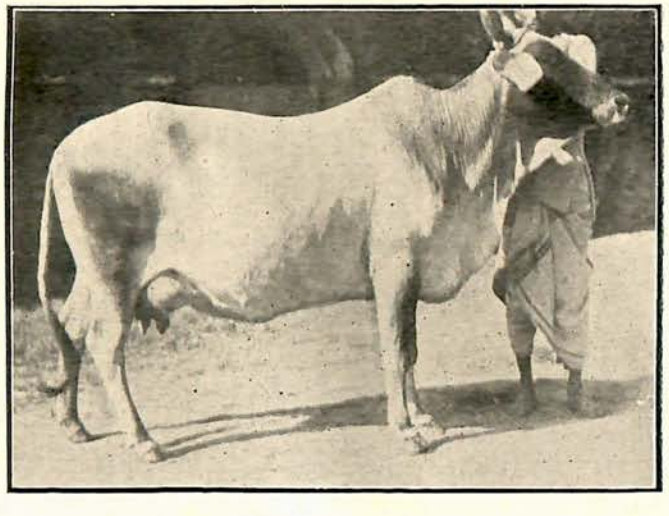


Pure Sahiwal cow Tutia No. 318, Pusa. Best actation, 5,865 lb. in 10 months.

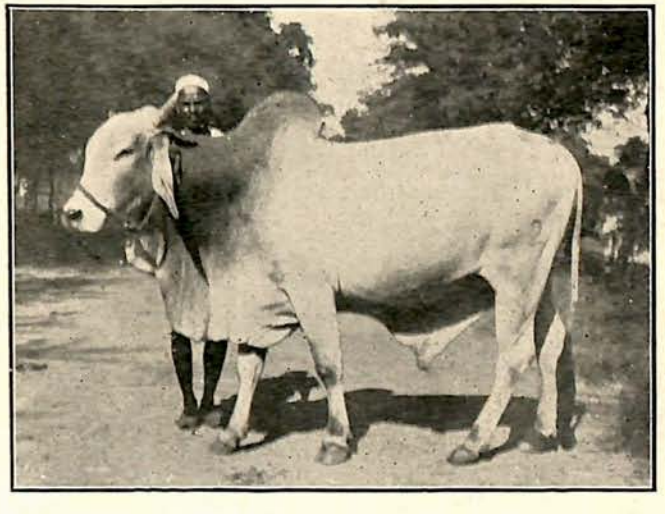


Group of Murra buffaloes, Bangalore Farm.

Group of Scindi cows, Bangalore Farm.



Thar-Parkar cow Gertie, Karnal Farm. Last calving on 29th October 1926; daily yield in January 1927, 19 lb.



Thar-Parkar bull Kurwell, Karnal Farm.

culture, is under consideration. In the meantime, a commencement has been made in compiling lists of all the pedigree cattle in the country available for sale. These lists will be circulated to all likely buyers. Steps are also being taken to form registers for herd record purposes of all Sahiwal and Scindi cattle suitable for registration.

As explained in previous reviews, cattle-breeding operations at PUSA have been directed along two lines: (1) a herd of Sahiwals is being graded up by selective breeding, and (2) the poorer milkers of the same breed are being crossed with Ayrshire bulls of high milking pedigree with the primary object of obtaining reliable information regarding the inheritance of observable characters in the crosses. In the pure Sahiwal herd of 78 cows, 35 have given over 4,000 lb. of milk per lactation of 300 days, and of these four have yielded over 6,000 lb. and eight over 5,000 lb. The half-bred Ayrshire-Sahiwal herd of 40 cows has given an average daily yield of 20 lb. per head; in this cross-bred herd there are 16 cows which have given over 6,000 lb. in a lactation. The average yield of 15·6 lb. per cow per day for the whole herd is as high as that of a good dairy herd in England. Having produced a cross of good milking capacity by adding Ayrshire blood and having proved that the sire is prepotent as regards milk production, our object is to adapt the cross to the needs of the country by mating the cross-bred dams with Sahiwal bulls of good milch pedigree. The resulting progeny, though not such heavy yielders as their half-bred ancestor, should be hardier and less susceptible to disease.

In accordance with the cross-breeding policy adopted at Pusa, the cross-bred cows on the BANGALORE and WELLINGTON farms are now sired by Indian bulls of good milch pedigree. At KARNAL, pure herds of Thar-Parkar and Hariana cattle and Murra buffaloes are being established. Hariana cattle occupy a high position amongst the breeds of India on account of their good draught qualities. The milking records of the Karnal farm, however, show that there are among them also cows which milk well.

Among all the provinces of India, the PUNJAB is the richest in its live stock. It is the home of the famous Hariana and Dhanni breeds of draught cattle, and also of the Sahiwal whose reputation as a milch breed has now spread all over India. The accepted

policy of the Veterinary Department, which is in charge of cattle-breeding operations at present, is to improve these breeds by a process of selection. By the rigid application of this principle, the Hissar breed of Hariana cattle has been established, the progeny of which are very popular throughout the canal-irrigated tracts of the province. During the year under review, 406 bulls of this breed were taken over by District Boards for service in villages: and 16 more were sold to other applicants. The issue of 422 bulls in a single year is a record even for Hissar which is the premier cattle-breeding farm in India. With a view to meeting the growing demand for bulls of the Hissar breed, grants of land have been made for three private cattle-breeding farms. Owners of approved bulls in the Hariana tract, which comprises the districts of Rohtak, Gurgaon and Hissar, are also subsidized on condition that their services are available for all local cattle. There are 463 such bulls at stud in Gurgaon alone, the District Board of which purchased 100 bulls from Hissar during the year. For the tract comprising the four districts of Rawalpindi, Attock, Jhelum and Mianwali there is a similar scheme in operation for the improvement of the Dhanni breed.

The improvement of the Sahiwal breed is receiving attention on three cattle-breeding and two dairy farms established by private owners on Government land specially allotted for the purpose. These farms which all maintain milk records are reported to have made good progress during the short term of their existence. Small parcels of land totalling 5,000 acres have also been granted to the Jungalis and Sayads in the original home of the Sahiwal breed on condition that they maintain thereon two approved cows per square of 25 acres. Milk recording societies have been started by the Co-operative Department amongst these smaller grantees.

From these various sources, 616 bulls were put at stud during the year, bringing the total number to 2,253.

In the NORTH-WEST FRONTIER PROVINCE, 34 bulls belonging to local bodies are at stud. A small but promising herd of Awankari cattle has been built up at Tarnab within the last ten years.

There are two cattle-breeding farms in the UNITED PROVINCES. The one at Madhurikund in the Muttra District deals with the well known Hissar or Hariana breed. Bulls of this breed have proved

themselves very suitable for grading up the local cattle in many of the western districts. With a view to increasing the supply of bulls, the area of the farm is being doubled, and two controlled breeding areas have been started in the districts of Muttra and Etawah, in which approved bulls are located in every village. The interest taken by the ryots in the bulls stationed in the controlled areas is very encouraging. These areas promise to become large breeding centres for the supply of bulls to other districts. The possibilities of the Hissar breed as milch animals are being investigated both by reserving some animals for dairy purposes and by crossing a few with Holstein-Friesian sires. On the other farm at Manjah are maintained pure herds of the local Kherigarh and Sahiwal cattle and Murra buffaloes. The Kherigarh, like the Hissar, is essentially a draught breed; an attempt is being made to produce dual-purpose types by crossing them with the Sahiwal. The Sahiwal and Murra breeds are standing Terai conditions well and are getting rapidly acclimatized. There are now 374 selected bulls of various breeds at stud in the province, of which 100 were distributed last year. The two village dairy schemes initiated with the help of Government subsidies in the Agra and Aligarh Districts have both proved profitable to the promoters, and stimulated the cattle-breeding industry in the localities concerned. The dairy at Agra has now been equipped with a pasteurizing plant, and the proprietor has launched a scheme for the supply of milk to Naini Tal from villages in the Terai.

At the Rangpur cattle-breeding farm in BENGAL both *desi* and imported Hansi bulls are used for mating with indigenous cows. The cross-bred bullocks are well built and suitable for cart work; the cows, too, are showing considerable improvement in milk yield. The Scindi and Thar-Parkar herds being acclimatized at Dacca are doing very well. A definite cattle-breeding policy for the province will be laid down on the appointment of a Live Stock Expert to the department.

In BIHAR, there are dairy farms at Sabour, Monghyr and Kanke, from which bulls of good milch pedigree are supplied to municipalities and private buyers. As recommended by the Cattle Committee appointed in 1925, the future programme includes the establishment of a cattle-breeding and dairy farm at Patna under

the Veterinary Department, a buffalo herd on the Sepaya farm in North Bihar, and a herd of local cows on the Cuttack farm in Orissa.

The attempt to grade up a herd of pure Patna cows has produced definite results at the Upper Shillong farm in ASSAM ; during the last seven years the daily average yield per cow has been more than doubled. Cattle of the Sahiwal breed have been introduced on the farm during the year. The scheme for establishing a cattle farm near Khanapara on the Gauhati-Shillong road has been accepted by Government. The primary object of this farm will be the improvement of draught bullocks required for work on the plains.

The proposed stock-breeding farm at Tatkon in BURMA has not yet materialized. The small herd of Scindi cattle established at the Mandalay college is doing well.

Three of the nine cattle-breeding farms in the CENTRAL PROVINCES, *viz.*, those at Telinkheri, Powarkhera and Garhi carry pure herds of Sahiwal, Malvi and Gaolao breeds, respectively. The last two are well known local draught breeds, good bulls of which are in great demand. The Sahiwal is essentially a dairy breed for urban areas, and it is the intention of the department to maintain bulls of this breed on all farms in close proximity to towns. On the Drug, Chandkhuri and Bilaspur farms local cows are being sired by Malvi bulls, while the bulls used on the Sindewahi, Borgaon and Khandwa farms are of the Sahiwal breed. Cross-breeding has, in both cases, resulted in an improvement in the first generation. The progeny of Malvi bulls have gained in size, while those of Sahiwal sires have gained in milk and draught. The dairy herds at Telinkheri and Nagpur are steadily improving in milk yield. There is a keen demand for cattle bred on Government farms ; 310 animals, including 59 bulls, were sold during the year. The 12 pure Gaolao bulls sold from the Garhi farm fetched an average price of Rs. 259 per head, the highest figure being Rs. 390 for a really splendid animal. The premium bull system, for the extension of which there is an almost unlimited field, is working very well ; 37 premia were granted during the year, including 18 renewed from the previous year. In some cases bulls of the required standard were allowed to be purchased from private breeding farms.

There are several good indigenous cattle breeds in the BOMBAY Presidency, and the energies of the department are directed towards their preservation and improvement. The breeds under improvement are the Kankrej at Chharodi and Surat, the Amrit Mahal at Bankapur, and the Scindi and Thar-Parkar at Karachi. A herd has been built up at each centre from which bulls are being supplied to cattle-owners for stud purposes. At Chharodi the milk yield of the Kankrej breed, valued for its draught qualities, has improved, and the cows are maturing nine months earlier. In the pure Scindi herd at Karachi there are two cows giving over 8,500 lb., two over 6,500 lb. and nine over 5,000 lb. per lactation. The herd of Gir cattle established by the Kandivali *gowshala*, with the aid of a subsidy from the department, is also flourishing.

Four cattle farms are maintained in MADRAS: the largest is at Hosur where pure herds of the Kangayam, Ongole, Scindi and Sahiwal breeds are under improvement. There are also Ayrshire, Shorthorn and Jersey cross-bred cows on this farm: these are being sired by Scindi and Sahiwal bulls of high milch pedigree. The best milkers from the mixed herd are periodically transferred to Coimbatore where a milch herd is maintained for teaching purposes. The Chintaladevi farm is solely devoted to the study of the Ongole breed, and the Guntur farm to the breeding of buffaloes.

The Agricultural Department in MYSORE having been relieved of the charge of the palace dairy farm at Rayenkere, cattle-breeding work is now concentrated at Hebbal.

On the two cattle farms in the TRAVANCORE State, pure herds of Scindi, Ongole and Mysore cattle are being maintained. The Scindi breed has adapted itself very well to its new environment. Grants were made in the year under report to 19 private persons who are maintaining stud bulls for the benefit of the public.

In BARODA, herds of Gir cattle and Jafferabadi buffaloes are being built up.

Sheep-breeding. There are over 11 million sheep in British India alone. The fleece in the case of most of our Indian breeds partakes of the nature of hair and is suitable only for the manufacture of coarse blankets. Experiments are therefore in progress in some provinces to grade up the indigenous sheep by selection and by cross-breeding with Merino and other superior wool breeds.

Climate and disease are the two factors which militate against the success of cross-breeding operations ; but the results so far produced, particularly as regards wool, encourage us to hope that the graded-up progeny will to some extent combine weight of wool with weight of carcase.

Sheep-breeding continues to receive attention on the Hissar farm in the PUNJAB. During the year under report, 58 cross-bred Merino rams were issued as against 20 in the previous year. With a view to helping the breeders to secure a fair price for the wool of their cross-breds, co-operative sheep-breeding societies have been established. There are five such societies working at present.

On the Tarnab farm in the NORTH-WEST FRONTIER PROVINCE, the local Hashtnagari ewes are being mated with the fat-tailed Pusht-i-Koh rams from Persia. There is a distinct improvement in the cross-bred progeny as regards both fleece and mutton, and arrangements are being made to import more Pusht-i-Koh rams.

The improvement of Deccan sheep is being effected in BOMBAY by the use of ¾-bred Merino rams from Hissar. The first generation shows a substantial increase in the weight and character of the fleece and in the size of the carcase.

In MADRAS, two flocks of local sheep—one white with black face and the other pure black—are being maintained at Hosur with a view to improvement in the quantity of the clip. There was an increase of 25 per cent. in the average yield of wool per sheep as compared with the previous year.

The average weight at birth of cross-bred Merino lambs as well as the results of clipping in respect of both quality and quantity continue to be satisfactory in MYSORE. The Kolar Sheep Breeders' Association, which has 119 members, carries on systematic breeding with half-bred Merino rams obtained from State farms.

Poultry-breeding. The successful work in poultry-breeding carried on at Lucknow under Government auspices and at Etah by a missionary philanthropist has aroused considerable interest in the development of this valuable subsidiary agricultural industry. At both places it has been proved that highly fecund poultry imported from overseas can be successfully acclimatized in India, and that the small domestic Indian fowl can be graded up and improved in one generation by mating her with males of pure-

bred fecund stock. That poultry-breeding is a suitable subsidiary industry for the ryot has been amply demonstrated by Mr. Slater in some of the poorest villages of Etah. Owing to financial stringency and paucity of staff, poultry-breeding in India has not received from the Department of Agriculture attention commensurate with its great possibilities. A beginning has, however, been made, and other provinces are making arrangements to follow in the wake of the United Provinces.

CHAPTER IX.

PUBLICATIONS OF THE AGRICULTURAL DEPARTMENTS.

A complete list of agricultural publications issued during the year under review is given in Appendix XI (page 135). Briefly summarized, those issued by the Imperial and Provincial Departments of Agriculture are as follows :—

Imperial. Eighteen memoirs, seven bulletins and nine other publications were issued during the year, while 13 publications were in the press on 30th June, 1926. The publications issued dealt with subjects of general importance such as nitrogen recuperation in the soils of Bombay, determination of available phosphoric acid in calcareous soils, the curing of tobacco, the chemistry of silage, nutrients required for milk production, the grasses and grasslands of Bombay, the Wagad cotton of Gujarat, the control of the red pumpkin beetle, the transmission of rinderpest by means of insects, nasal granuloma in cattle, the bacteriology of milk, bot flies of the Punjab, the prevention of loss of sugar by inversion in factories, standard methods of analysing fertilizers, etc.

" The Agricultural Journal of India," which is issued every two months, continues to maintain its popularity among the class of readers for which it is intended.

Provincial. Five bulletins and five leaflets with their vernacular versions were issued in BOMBAY. Ridge cultivation, Elephant grass and the manuring of sugarcane are some of the subjects dealt with in these publications.

The monthly digest of the operations of the Madras Agricultural Department was published, as before, in English and the three principal vernaculars of the presidency for circulation among agriculturists. Over 77,000 copies of the Villagers' Calendar printed in five languages were also distributed and sold. In view of the popularity of the English edition of " A Notebook on Agricultural Facts and Figures," a Tamil edition was issued. Leaflets on the preparation of silage and the growing of green manure crops were published during the year.

The quarterly journal of the BENGAL department continued to be published in English and Bengalee. One of the bulletins issued

is intended to give the public an idea of the different activities of the department.

The publication in the UNITED PROVINCES of the departmental monthly journals issued in Hindi (Kisan-Upakarak) and Urdu (Mufid-ul-Mazarain) from Partabgarh was continued.

Among the three leaflets issued in BIHAR, one is on the preparation of refined *gur*.

The half-yearly "Seasonal Notes" has met with public approval in the PUNJAB. The occasional publications included a leaflet on the Lantana weed and a bulletin on the treatment of foot-and-mouth disease.

In the CENTRAL PROVINCES, the "Nagpur Agricultural College Magazine" started during the year is being published quarterly. A bulletin on sugarcane cultivation was published by the department.

In addition to the Agricultural Calendar published in Burmese, of which over 6,000 copies were distributed, two bulletins were issued in BURMA.

In ASSAM, a bulletin on prevention of disease in potatoes was brought out.

CHAPTER X.

RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL DEPARTMENTS.

The total expenditure incurred by the Imperial Department of Agriculture during the financial year ending 31st March, 1926, was Rs. 9,53,477. The gross receipts of the Agricultural Research Institute, Pusa, from the sale of farm produce, cattle, milk, etc., and subscriptions to the Sugar Cable Service amounted to Rs. 1,22,100.

	Rs.
General expenditure of the Pusa Institute (including the office of the Agricultural Adviser and Director)	2,85,117
Botanical Section	44,137
Chemical Section	53,137
Bacteriological Section	59,842
Mycological Section	31,527
Entomological Section	70,456
Agricultural Section	1,28,413
Sugar Bureau	34,480
Sugar Cable Service	27,239
Imperial Dairy Expert	43,591
Physiological Chemist	46,635
Government Sugarcane Expert	1,28,903
TOTAL	9,53,477

The receipts and expenditure of the three dairy farms and one creamery under the control of the Imperial Dairy Expert were Rs. 3,23,606 and Rs. 4,49,593, respectively, for the financial year 1925-26 as detailed below:

Name of farm	Receipts	Expenditure
	Rs.	Rs.
Bangalore	1,51,391	1,73,839
Wellington	83,913	1,05,980
Karnal	78,351	1,14,424
Anand (Creamery)	9,951*	55,350
TOTAL	3,23,606	4,49,593

* Rs. 7,563 were also due to the Creamery on 31st March, 1926, and on the same date there was stock in hand valued at Rs. 19,895.

The following tabular statement shows the receipts and expenditure of the Provincial Departments of Agriculture for the year 1925-26. The respective figures for the previous year were Rs. 21,55,055 and Rs. 95,37,043 :—

Province	Receipts	Expenditure
	Rs.	Rs.
Bombay	3,09,180	16,40,250
Madras	2,41,000	15,42,206
Bengal	1,58,703	8,86,527
Bihar and Orissa	99,451	5,48,150
United Provinces	3,17,480	19,40,419
Punjab	5,56,884	19,28,035
Burma	60,062	13,84,829
Central Provinces	2,59,154	8,59,521
Assam	98,310	3,01,473
North-West Frontier Province	35,638	95,440
Baluchistan	11,442	11,798
TOTAL	21,47,304	1,11,38,648

A rise of 16 lakhs of rupees in the gross expenditure of the Provincial Departments of Agriculture is a satisfactory feature of the above table. The provinces principally contributing towards the increase are the Punjab, Burma and the United Provinces. A decrease is reported from the Central Provinces, while the figure for Bengal is practically stationary.

As pointed out in last year's report, the inadequacy of the provision made in the provinces for agricultural research is another great handicap to progress. We have as yet but touched the fringe of the agricultural problems awaiting solution. In no industry

perhaps are the problems more complex than in agriculture; their number is almost overwhelming. Many of these problems are peculiar to India; only a small percentage of the research work done in other countries is applicable to conditions here. The paucity of research workers, the variety of problems, and the variety, too, of the soil and climatic conditions under which they are being investigated, make co-ordination and co-operation all the more necessary. If each province is to be self-contained as far as its research workers are concerned and to work out its own problems independently, progress will be slow.

APPENDIX I.

Areas under new and improved varieties of crops during 1925-26.

Province	Crop	Advantages	Area in acres						Remarks
			1925-26			1924-25			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Bombay	Cotton—								
	1027 A. L. F.	Lint fetches a premium of Rs. 15-25 per candy (798 lb.).	142,956	300,000	442,956	160,000	225,000	385,000	
	1-A Cylindrical Boll type.	..	..	..	..	1,700	..	1,700	
	Kanmi	..	..	..	..	100	4,000	4,100	
	Neglectum roseum	Early ripening ; avoids frost ; yields Rs. 7 more per acre.	28,930	206,970	235,900	43,605	40,000	83,605	
	Surat cotton	Selected uniform seed	..	5,588	5,588	..	2,200	2,200	
	Dharwar No. 1	Uniform staple, higher ginning percentage, resistant to red leaf.	119,000	40,000	159,000	93,257	30,000	123,257	
	Gadag No. 1	Uniform staple, higher ginning percentage, resistant to red leaf.	100,000	50,000	150,000	119,632	80,000	199,632	
	Punjab-American 4 F. and 285 F.	Prolific, hardy, early ,commands a premium of 12-25 per cent.	8,000	25,000	33,000	12,000	9,000	21,000	
	Desi 27 W.N.	Prolific, special rough feel, bright colour, higher ginning percentage.	16,000	1,000	17,000	5,454	1,000	6,454	
	Groundnut	Early maturing ; profitable rotation crop	23,804	340,206	364,010	15,267	229,800	245,067	
	Sugarcane (Red Mauritius and Manjav).	Higher yield of cane and *gur*, do not lodge, not attacked by jackals, free from red rot.	264	2,000	2,264	50	1,541	1,591	
	Bajra (Akola)	Better quality grain and higher yield	125	..	125	600	..	600	
	Wheat (Pusa 4 and Buxi)	Better yield and less affected by smut	1,051	12,000	13,051	2,200	10,550	12,750	
	Paddy (selected strains of Kolamba).	Higher yielding capacity	3,234	62,400	65,634	4,077	4,475	8,552	

Areas under new and improved varieties of crops during 1925-26—contd.

Province	Crop	Advantages	Area in acres						Remarks
			1925-26			1924-25			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Madras	Paddy	Better yielders and more profitable to cultivators.	9,549	112,633	122,182	8,025	97,118	105,143	
	Sugarcane		2,200	18,302	20,562	1,615	12,967	14,582	
	Cotton		86,611	287,057	373,668	67,955	371,755	439,710	
	Miscellaneous		36,125	38,458	74,583	22,890	49,431	71,821	
Bengal	Paddy (Indrasail, Dudshar and Kataktara).	Capable of largely increased yields as compared with local paddies under suitable conditions.	13,799	119,471	133,270	20,094	100,725	120,819	
	Jute (D. 154 and Chinsura Green).	Heaviest yielding types of *C. capsularis* and *C. olitorius*, respectively, yet met with.	50,634	282,138	332,772	97,100	200,672	297,772	
	Sugarcane (Tanna and Co. 213).	Tanna is a good drought-resister, stands water-logging, resists jackals and pigs, is practically free from disease. Co. 213 shows also greatest promise.	6,706	24,101	30,907	20,603	5,070	25,673	
	Other crops	More profitable to cultivators	105	516	621	14	90	104	
Bihar and Orissa	Paddy (Dahia, Kakharua, C. P. Lochai, Types I, II and III, Indrasail, Badsabhog).	Earliness and heavy yielders	1,820	33,720	35,540	1,799	24,062	25,861	
	Sugarcane (Co.205, 210, 213, 214, Mungo, M. 2).	Greater outturn in actual cane and sugar per acre.	153	5,130	5,283	46	5,987	6,033	Over 7,000 acres are reported under Co. canes by the Sugar Bureau.
	Groundnut (No. 17)	Profitable crop on poor lands	118	2,052	2,170	41	1,933	1,974	
	Tobacco (Pusa 28)	Crop not formerly grown to any considerable extent in Saran District.	100	100	200	5	..	5	
	Gram (No. 4)	Heavy yielder	57		57	28	..	28	
	Wheat (Pusa 4, 12)	Prolific yielders	43	685	728	89	345	434	
	Dhaincha	Economical green manure for paddy lands	47	7,010	7,057	101	6,007	6,108	

United Provinces	Wheat (Pusa 4, 12, 54, 110 ; C. 13, 46 ; Muzaffarnagar, etc.).	High yielding and rust-resisting	44,138	800,000	844,138	24,623	750,000	774,623
	Cotton (C.A. 9, J. N. 1, K. 22, A. 19, C. 402, C. 1031, American cotton, etc.).	Superior to *desi* cotton, better lint and higher ginning percentage.	17,134	28,550	45,684	10,759	30,293	41,052
	Sugarcane (S. 39, 48, 50 ; A. 42, 47 ; Co. 213, 214 ; Uba ; Barbados ; Mauritius 16, etc.).	Give more outturn of cane and 50 per cent. of *gur* more than local varieties.	7,740	92,260	100,000	5,165	12,602	17,767
	Barley (Ballia, etc.)	Better yielder than local var]	20,407	..	20,407	17,078	..	17,078
	Gram (Pusa yellow, black, etc.).	Produce and quality better than local varieties.	26,301	9,879	36,180	19,830	7,007	26,837
	Miscellaneous (Jaunpur maize, Cawnpore Dudania *juar*, awned *bajra*, large Japanese and Virginian bunch groundnuts, *juar*, etc.)	Better yielders than local varieties	34,263	12,646	46,909	29,578	5,968	35,546
Punjab	Cotton—							
	American 4 F.	Long-stapled variety ; yields more than *desi* cottons and fetches a premium of Rs. 3-6 per maund of seed-cotton.	21,935	965,636	987,571	224,120	812,713	1,036,833
	American 285 F.	Spins finer than 4 F. and also more drought resistant and earlier.	9,952	248	10,200	7,195	21,036	9,831
	Desi No. 24	Improved *desi* variety	47,650	38,043	85,693	22,667	8,604	31,271
	White-flowered neglectum.	More yield and higher lint percentage	18,855	109,700	128,555	21,548	35,672	57,220
	Wheat (Punjab 11, 17, 8a ; Pusa 4, 12).	More yield, fetch better price, possess good milling and baking qualities, ripen early.	86,753	1,070,193	1,156,946	68,426	1,074,640	1,183,066
	Sugarcane (Bihar, Co. 205.)	High yield	689	10,331	11,020	518	8,318	8,836
Burma	Paddy	Uniformity and freedom from red grain. High milling capacity.	..	..	179,981	..	..	187,612
	Groundnut	High oil capacity, early maturity ; easy to harvest.	..	..	6,298	..	..	10,741
	Cotton (Indigenous selection and Cambodia).	More profitable to cultivate	..	..	8,785	..	..	5,232
	Gram	Immunity to wilt disease	..	..	59,361	..	..	22,466

Areas under new and improved varieties of crops during 1925-26—concld.

Province	Crop	Advantages	Area in acres						Remarks
			1925-26			1924-25			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Central Provinces	Wheat	Better yielders	..	..	125,138	..	..	104,232	Figures based on seed farms only. Actuals under improved seed 3-4 times the figures.
	Paddy		..	..	108,057	..	..	118,865	Ditto.
	Cotton		..	..	514,904	..	..	571,350	Largely based on seed issued from recognized seed farms.
	Juar (Sorghum)		..	..	65,080	..	..	59,973	
	Groundnut		..	..	28,691	..	..	12,552	
	Other crops		..	..	2,554	..	..	5,666	
Assam	Paddy	Higher yielders than *desi* varieties	660	9,008	9,668	1,130	1,926	3,056	
	Jute		1,197	2,516	3,713	554	1,194	1,748	
	Sugarcane		34	938	972	26	226	252	
	Potato		313	311	624	213	206	419	
North-West Frontier Province.	Wheat (Pusa 4)	Ripens early, yields well, does not lodge, resists rust.	..	..	202,000	..	..	202,000	
	Sugarcane (Red Assami)	Ripens early, is vigorous and little affected by diseases and insects.	..	..	800	..	..	600	
	Berseem	Yields better than shaftal and is less liable to cause hoven	..	..	8,000	..	..	5,000	
	Fruits	Superior varieties	..	..	800	..	..	500	
	Maize	Ditto.	..	..	6,000	..	..	5,000	

APPENDIX II.

List of Agricultural Stations in British India in 1925-26.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bombay	Surat	292	Superintendent	Deputy Director of Agriculture, Gujarat, Surat.	Cotton and *juar* research station.
	Amalsad	19	Overseer		Sugarcane farm.
	Nadiad	44	Tobacco Breeder		Tobacco farm.
	Broach	6	Cotton Breeder, South Gujarat.		Cotton and *juar* farm.
	Dohad	57	Superintendent		Cotton farm.
	Viramgam	6	Cotton Breeder, North Gujarat.		Wagad cotton breeding.
	Dhulia	28	Headmaster, Vernacular Agricultural School.	Deputy Director of Agriculture, North Central Division, Nasik.	Vernacular Agricultural School.
	Jalgaon	204	Superintendent		Seed farm.
	Kopargaon	115	Ditto	Deputy Director of Agriculture, South Central Division, Poona.	Sugarcane confirmation station.
	Baramati	21	Overseer		Sugarcane farm.
	Manjri	62	Ditto		Sugarcane experimental station.
	Mohol	49	Ditto		Cotton seed farm.
	Dharwar	134	Superintendent	Deputy Director of Agriculture, Southern Division, Dharwar.	
	Gokak Canal (Arbhavi)	62	Ditto		
	Mugad	6	Ditto		Rice breeding.
	Tegur	370	Fieldman		Cattle-breeding farm.
	Chharodi	2,251	Manager	Live Stock Expert to Government, Bombay, Poona.	Kankrej cattle-breeding farm.
	Bankapur	256	Ditto		Amrit Mahal cattle-breeding farm.
	Karachi (Lord Willingdon Cattle Farm).	800	Ditto		Sindi cattle-breeding farm.

List of Agricultural Stations in British India in 1925-26—contd.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Bombay—*concld.*	Ratnagiri	102	Superintendent	Deputy Director of Agriculture, Konkan, Ratnagiri.	*Nagli* breeding.
	Kumta	19	Ditto		
	Karjat	7	Rice Specialist		
	Karjat	6	Superintendent	Crop Botanist to Government, Bombay, Poona.	Rice breeding station.
	Kirkee	2	Ditto		Wheat breeding station.
	Mirpurkhas	200	Ditto	Deputy Director of Agriculture, Sind, Karachi.	Seed farm.
	Mirpurkhas	60	Ditto		
	Sukkur	30	Ditto		
	Larkana	65	Ditto		
	Jacobabad	300	Ditto		Wheat farm.
	Ganeshkhind, Kirkee	80	Ditto	Horticulturist to Government, Poona.	Botanical gardens.
	Modi Bag, Poona	11	Ditto		
	Poona	289	Ditto	Professor of Agriculture, Poona Agricultural College.	Agricultural College farm.
	Kirkee	362	Manager		Agricultural College dairy.
Madras	Coimbatore	440	Ditto	Superintendent, Central Farm, Coimbatore.	Central farm attached to the Agricultural College.
	Samalkota	57	Ditto	Deputy Director of Agriculture, I Circle, Vizagapatam.	
	Anakapalli	41	Ditto		
	Guntur	150	Ditto	Deputy Director of Agriculture, II Circle, Guntur.	
	Hagari	225	Ditto	Deputy Director of Agriculture, III Circle, Bellary.	
	Nandyal	102	Ditto		
	Palur	64	Ditto	Deputy Director of Agriculture, IV Circle, St. Thomas' Mount.	
	Palakuppam	16	Ditto		Groundnut station.

	Kollpatti	125	Ditto	Deputy Director of Agriculture, VI Circle, Madura.	
	Kasargod	106	Ditto	Deputy Director of Agriculture, VII Circle, Tellicherry.	West Coast coconut station.
	Taliparamba	86	Ditto		
	Vellalore	2	Ditto	Deputy Director of Agriculture, VIII Circle, Coimbatore.	Betle-vine station.
	Nanjanad	36	Manager	Curator, Government Botanic Gardens, Ootacamund.	Seed potato farm.
	Coonoor	..	Assistant Manager		Pomological station.
	Chintaladevi	850	Manager	Deputy Director of Agriculture, Live-stock, Hosur.	Cattle farm.
	Guntur	150	Assistant Manager		Buffalo breeding station.
	Hosur	1,635	Manager		Central cattle farm.
	Dacca	354	Chief Superintendent	Deputy Director of Agriculture, Eastern Circle.	
	Mymensingh	20	District Agricultural Officer.		
	Faridpur	20	Ditto		
	Comilla	20	Ditto		
	Barisal	20	Ditto		
	Kishoreganj	83	Ditto		
	Jamalpur	27	Ditto		
	Dhanbari	7	Agricultural Demonstrator		
Bengal	Rajshahi	63	Superintendent	Deputy Director of Agriculture, Northern Circle.	
	Rangpur	333	Ditto		Cattle farm.
	Burirhat (Rangpur)	52	Ditto		Tobacco farm.
	Rangpur	19	District Agricultural Officer		Demonstration farm.
	Bogra (old)	23	Ditto		
	Bogra (new)	6	Ditto		
	Pabna	20	Ditto		
	Dinajpur	24	Ditto		
	Mainaguri	25	Ditto		

List of Agricultural Stations in British India in 1925-26—contd.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Bengal—*concld.*	Chinsura	210	Chief Superintendent	Deputy Director of Agriculture, Western Circle.	
	Burdwan	35	District Agricultural Officer		
	Berhampore	44	Ditto	Deputy Director, Western Circle, and Superintendent, Burdwan Division.	
	Bankura	29	Ditto		
	Suri	33	Ditto		
	Jessore	5	Ditto		
	Gosaba	8	Agricultural Officer		
	Kalimpong	76	Manager	Director of Agriculture, Bengal	
	Kalimpong, Kurseong and Berhampore.	..	Superintendent of Sericulture.	Deputy Director of Sericulture	Sericultural research stations.
Bihar and Orissa	Sabour	190	Probationary Assistant Director of Agriculture.	Director of Agriculture.	
	Jamui	38	Inspector	Assistant Director of Agriculture, Bhagalpur Circle.	
	Banka	26	Ditto		
	Monghyr	200	Superintendent	Assistant Director of Agriculture, Monghyr.	Dairy farm.
	Gaya	193	Manager	Deputy Director of Agriculture, Patna Circle, Patna.	
	Nawadah	67	Inspector		
	Bikramganj	24	Overseer		
	Kanke	340	Manager	Deputy Director of Agriculture, Chota Nagpur Circle, Kanke, Ranchi.	
	Netarhat	193	Overseer		Potato farm.
	Purulia	52	Inspector		
	Ramgarh	43	Overseer		
	Chianki	32	Ditto		
	Sambalpur	32	Inspector		
	Chaibassa	38	Overseer		

	Cuttack	150	Assistant Director of Agriculture.		
	Khurda	31	Inspector	Deputy Director of Agriculture, Orissa Circle, Cuttack.	
	Balasore	75	Ditto		
	Angul	47	Overseer		
	Puri	42	Ditto		
	Sopaya	379	Manager	Deputy Director of Agriculture, North Bihar Range.	
	Siwan	20	Overseer		
United Provinces	Cawnpore	71	Superintendent	Deputy Director of Agriculture, Central Circle, Cawnpore.	
	Kalianpur (Cawnpore)	263	Ditto		
	Mainpuri	53	Ditto		
	Etawah	61	Ditto		
	Hardoi	55	Ditto		
	Atarra (Banda)	171	Ditto	Deputy Director of Agriculture, Bundelkhand Circle.	
	Jaitpur (Hamirpur)	31	Overseer		
	Fartabgarh	90	Superintendent	Deputy Director of Agriculture, Eastern Circle, Fartabgarh.	
	Naugawan (Sultanpur)	400	Ditto		
	Fyzabad	206	Ditto		
	Benares	78	Ditto		
	Aligarh	88	Ditto	Deputy Director of Agriculture, Western Circle, Aligarh.	
	Kalai (Allgarh)	142	Ditto		
	Muzaffarnagar	100	Ditto		
	Bichpuri (Agra)	100	Ditto		
	Jachonda (Muttra)	36	Inspector		
	Bulandshahr	25	Ditto		
	Gorakhpur	110	Overseer	Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur.	
	Bahraich	21	Ditto		

List of Agricultural Stations in British India in 192-265—contd.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
United Provinces—*concld.*	Shahjahanpur	163	Overseer	Deputy Director of Agriculture, Rohilkhand Circle.	
	Jeolikote (Naini Tal)	51	Inspector		
	Nawabganj (Bareilly)	119	Ditto		
	Nagina (Bijnor)	77	Superintendent		
Punjab	Lyallpur—				
	Agricultural Farm	473	Manager	Professor of Agriculture, Punjab, Lyallpur.	
	Students' Farm	78			
	Botanical Farm	120	Assistant to Economic Botanist.	Economic Botanist to Government, Punjab, Lyallpur.	
	Risalwala	1,078	Manager	Professor of Agriculture, Punjab, Lyallpur.	
	Montgomery	548	Agricultural Assistant	Deputy Director of Agriculture, Montgomery.	Mainly a seed farm.
	Shergarh	261	Ditto		Demonstration farm.
	Raewind	46	Ditto		District Board demonstration farm.
	Gurdaspur	161	Manager	Deputy Director of Agriculture, Gurdaspur.	Experimental station.
	Sargodha	657	Ditto		*Ditto* and seed farm.
	Chillianwalla	250	Ditto		Seed farm.
	Beas	43	Ditto		Demonstration farm.
	Kala Shah Kaku	146	Ditto		Rice-breeding station.
	Gujrat	50	Ditto		Demonstration farm.
	Hansi	589	Ditto	Deputy Director of Agriculture, Hansi.	Experimental station.
	Sirsa	419	Ditto		*Ditto*
	Multan	530	Ditto	Deputy Director of Agriculture, Multan.	Being acquired.
	Harappa Road	560	Agricultural Assistant	Deputy Director of Agriculture, Lyallpur.	For reclamation of saline soils.

Burma	Mandalay	660	Superintendent	Professor of Agriculture, Mandalay Agricultural College.	Agricultural College farm.
	Tatkon	106	Ditto	Deputy Director of Agriculture, East Central Circle.	
	Pyinmana	55	Ditto		
	Yawnghwe	37	Ditto		
	Mahlaing	248	Ditto	Deputy Director of Agriculture, Myingyan Circle.	
	Padu	105	Ditto		
	Allanmyo	143	Ditto	Deputy Director of Agriculture, West Central Circle.	
	Pwinbyu	22	Ditto		
	Sa-aing	12	Ditto		
	Hmawbi	433	Ditto	Deputy Director of Agriculture, Southern Circle.	
	Akyab	138	Ditto	Deputy Director of Agriculture, Arakan Circle.	
	Kyaukpyu	23	Ditto		
	Myaungmya	92	Ditto	Deputy Director of Agriculture, Irrawaddy Circle.	
	Mudon	88	Ditto	Deputy Director of Agriculture, Tenasserim Circle.	
Central Provinces	Nagpur	268	Ditto	Principal, Agricultural College, Nagpur.	College farm.
	Akola	271	Ditto	Economic Botanist, Nagpur.	
	Borgaon	368	Ditto	Deputy Director of Agriculture, Western Circle, Amraoti.	
	Yeotmal	106	Ditto		
	Khandwa	177	Ditto		
	Basim	109	Ditto		
	Sindewahi	197	Ditto	Deputy Director of Agriculture, Southern Circle, Nagpur.	
	Tharsa	116	Ditto		
	Wara-Seoni	63	Ditto		
	Chandkhuri	333	Ditto	Deputy Director of Agriculture, Eastern Circle, Raipur.	
	Bilaspur	253	Ditto		
	Drug	281	Ditto		
	Raipur	229	Ditto		

List of Agricultural Stations in British India in 1925-26—concld.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	REMARKS
Central Provinces—*concld.*	Seoni	164	Superintendent	Assistant Director of Agriculture, Chhindwara.	
	Chhindwara	69	Ditto		
	Betul	161	Ditto		
	Powarkhera (Hoshangabad)	528	Ditto	Deputy Director of Agriculture, Northern Circle, Jubbulpore.	
	Adhartal (Jubbulpore)	637	Ditto		
	Saugor	161	Ditto		
	Damoh	152	Ditto		
	Telinkheri	1,000	Ditto	Deputy Director of Agriculture in charge Animal Husbandry, Nagpur.	Dairy farm.
	Raigarh (Garhi)	1,200	Ditto		Cattle-breeding farm.
Assam	Jorhat	59	Manager	Deputy Director of Agriculture, Assam.	Sugarcane station.
	Titabor	120	Ditto		Rice station.
	Upper-Shillong	367	Ditto		Potato station.
	Karimganj	80	Ditto		Rice station.
North-West Frontier Province	Tarnab (Peshawar)	200	Ditto	Agricultural Officer, North-West Frontier Province, Tarnab.	
	Haripur	20	Ditto		
Imperial Department of Agriculture	Pusa	625	Overseer	Imperial Agriculturist.	
	Bangalore	258	Superintendent	Imperial Dairy Expert	Dairy farms.
	Wellington	69	Ditto		
	Karnal	2,154	Ditto		
	Coimbatore	90	Manager	Government Sugarcane Expert	Imperial Sugarcane Station.

APPENDIX III.

(a) *Quantities of different kinds of manures exported abroad by sea from British India during the last five official years 1921-22 to 1925-26.*

Oilcakes (for fodder and manures) (a)	1921-22	1922-23	1923-24	1924-25	1925-26
	Tons	Tons	Tons	Tons	Tons
Castor cake	864	952	1,107	1,410	1,212
Coconut cake	3,346	942	1,540	1,317	3,064
Cotton cake	1,932	3,429	2,174	4,190	5,773
Groundnut cake	55,643	64,370	65,386	95,049	83,247
Linseed cake	11,120	11,312	15,508	16,404	20,039
Rape and sesamum cake	38,786	62,018	85,727	68,308	65,842
Others	1,237	8,096	6,602	8,085	12,160
TOTAL OILCAKES	112,928	151,119	178,044	194,763	191,337
Manures—					
Bones—Crushed	38,920	46,493	57,365	36,079	44,650
Bones—Uncrushed	209	411	121	545	389
Bonemeal	49,876	37,667	38,209	34,363	39,258
Fish manures	6,033	10,162	11,567	11,414	4,125
Fish guano	3,424	8,674	16,584	6,832	5,054
Hornmeal (b)	..	..	..	..	1,829
Sulphate of ammonia	2,987	2,069	5,064	10,253	4,279
Other kinds	3,661	4,584	1,819	2,301	4,336
TOTAL MANURES	105,110	110,060	130,729	101,787	103,920
Saltpetre	11,747	10,577	7,811	8,163	6,681
TOTAL (ALL KINDS)	229,785	271,776	316,584	304,713	301,938

(a) Oilcakes for fodder and for manures are not distinguished separately.
(b) Separately recorded from April 1925. Figures prior to April 1925 are not available.

(b) *Imports of manures by sea.*

	1921-22	1922-23	1923-24	1924-25	1925-26
	Tons	Tons	Tons	Tons	Tons
Oilcake	176	195	136	110	67
Saltpetre (a)	2	2	1	..	..
Sulphur	6,277	9,026	12,514	12,804	15,239
Artificial and mineral manures—					
Nitrate of soda	130	1,442	1,945	3,977	3,963
Sulphate of ammonia	5	306	765	203	4,724
Others	275	3,989	4,272	8,487	12,001
Fish manures	..	1	23	2,648	4,450
Hornmeal (b)	..	..	..	..	9
Other kinds of manures	549	2,245	2,769	529	806
TOTAL MANURES (including OILCAKES)	7,414	17,206	22,425	28,708	42,159

(a) Discontinued from 1924-25. Separate figures from 1924-25 are not therefore available.
(b) Separately specified from April 1925. Figures prior to 1925-26 are not therefore available.

(c) *Production of saltpetre, sulphate of ammonia and phosphate rock (apatite) during the five years ending 1924 (from the Records of the Geological Survey of India).*

	1920		1921		1922		1923		1924		1925	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	Tons	Rs.	Tons	Rs.	Tons	Rs.	Tons	Rs.	Tons	Rs.	Tons	Rs.
Saltpetre	16,874	59,08,539	15,894	53,55,478	11,673	35,22,095	8,716	22,92,834	8,543	25,34,037	(a)	(a)
Sulphate of ammonia . . .	3,732	(a)	3,212	(a)	2,934	(a)	7,393	(a)	12,610 (b)	(a)	14,800 (b)	(a)
Phosphate rock (apatite) . .	(a)	(a)	347	3,420	1,340	17,000	4,762	80,820	6,426	68,004	(a)	(a)

(a) Not available.
(b) Supplied by Messrs. Shaw, Wallace & Co., Calcutta. Includes 1,000 tons estimated to have been produced by producers outside the British Sulphate of Ammonia Federation.

APPENDIX IV.

Showing results of well-boring during 1925-26.

Province	1925-26		1924-25	
	Number of bores	Number successful	Number of bores	Number successful
Bombay	206	116	164	104
Madras	508	345	690	433
Bengal	8	7	11	10
Bihar and Orissa	154	134	120	111
United Provinces	673	510	656	447
Punjab	284	225	238	188
Burma	1	..	..	..

APPENDIX V.

Showing sale of improved implements through departmental agency during 1925-26.

Province	Ploughs		Cane mills		Fodder cutters		Hoes		Other implements		Spare parts	
	1925-26	1924-25	1925-26	1924-25	1925-26	1924-25	1925-26	1924-25	1925-26	1924-25	1925-26	1924-25
Bombay*	1,809	2,470	30	12	8	11	92	39	312	130	311†	195
Madras	1,713	1,834	6	11	33	41	4	2	415	488	2,597	2,681
Bengal	7	9	5	6	2	..	3	1	5	8	3	..
Bihar and Orissa	1	..	2	2	..	..	..	..	3	2	..	..
United Provinces	3,212	2,633	116	105	35	37	15	5	316	221	5,139	4,701
Punjab	5,410	5,329	289	6	1,487	941	94	52	3,887	5,086	3,181	2,451
Central Provinces	4,262	7,672	109	192	31	41	678	462	389	463	4,397	4,218
Burma	485	596	1	..	45	..	..	..	75	191	1,355	..
Assam	8	8	159	231	..	..	..	6	50	71	..	16

* With the growth of private trade, there has been a decrease in sales through departmental agency.
† In addition, spare parts of the value of Rs. 4,856 were sold from the Poona College farm and in the canal area of the S. C. Division.

APPENDIX VI.

Agricultural Colleges and Schools in British India during 1925-26.

Name of College or School	Courses of Instruction	1925-26				1924-25				Remarks
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
				(a) Post-graduate Training Institutions.						
Agricultural Research Institute, Pusa.	Two-year Post-graduate Course.	28	6	10	2	32	6	5	..	In addition, 7 students received short courses of training in 1925-26.
Imperial Institute of Animal Husbandry and Dairying, Bangalore.	(1) Fifteen-month Post-graduate Course.	6	1	3	2	2?	2	7	5	
	(2) Two-year Indian Dairy Diploma Course.	69	23	36	9	..	..	13	..	
	(3) Short Courses, Animal Husbandry and Co-operative Dairying for varying periods.	62	62	65	57	7	7	7	4	
				(b) Provincial Agricultural Colleges.						
Agricultural College, Poona.	(1) Three-year B.Ag. Degree Course.	136	108	200	25	93	75	175	59	Affiliated to the University of Bombay.
	(2) College Diploma Course.	..	..	..	9	..	..	..	..	
Agricultural College, Coimbatore.	Three-year B.Sc.Ag. Degree Course.	68	25	48	7	49	20	39	12	Affiliated to the University of Madras.
Agricultural College, Cawnpore.	(1) Four-year L.Ag. Diploma Course.	78	31	78	20	51	21	69	16	
	(2) Two-year Certificate Course.	80	35	50	12	80	27	47	18	
Punjab Agricultural College, Lyallpur.	(1) Four-year B.Sc.Ag. Degree Course.	400	67	169	25	140	64	170	24	Affiliated to the University of Punjab.
	(2) One-and-a-half-year M.Sc. Degree Course.	..	..	..	..					
	(3) Two-year Certificate Course.	15	15	12	9					

Agricultural Colleges and Schools in British India during 1925-26—contd.

Name of College or School	Courses of Instruction	1925-26				1924-25				Remarks
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
Punjab Agricultural College, Lyallpur.	(4) Six-month Vernacular Course.	38	31	21	18	66	52	22	19	
	(5) One-month Rural Economy Course.	16	16	14	14	15	15	15	15	
	(6) Ten-and-a-half-month Teachers' Training Course.	40	30	30	30	32	30	26	26	
	(7) Six-week Blacksmith Class.	15	15	11	11	7	7	7	7	
Agricultural College, Nagpur.	(1) Three-and-a-half-year Diploma Course.	97	51	82	5	107	50	76	5	
	(2) Two-year Certificate Course.	20	13	25	7	37	17	25	5	
Agricultural College, Mandalay.	Three-year Diploma Course.	38	22	48	..	36	19	30	..	Final diploma examination has not yet been held.
Bombay.				(c) *Agricultural Schools.*						
Vernacular Agricultural School, Loni Kalbhor (in Marathi).	Two-year Course . .	80	32	40	12	73	24	42	16	
Vernacular Agricultural School, Devihosur (in Kanarese).	Ditto . .	83	15	26	11	58	15	25	12	
Vernacular Agricultural School, Jambul (in Marathi).	Ditto . .	30	13	25	12	35	18	21	5	
Vernacular Agricultural School, Godhra (in Gujarati).	Ditto . .	42	19	30	14	60	17	31	13	
Vernacular Agricultural School, Dhulia (in Marathi).	Ditto . .	40	24	29	12	37	22	22	8	
Vernacular Agricultural School, Surat (in Gujarati).	Ditto . .	35	14	31	8	32	17	26	13	

Madras.										
Agricultural Middle School, Taliparamba.	Two-year Course .	24	14	31	18	33	27	34	13	
Agricultural Middle School, Anakapalli.	Ditto . .	35	12	17	10	50	29	21	6	
Bengal.										
Secondary Agricultural School, Dacca.	Two-year Course for regular students, and 1-year Course for Demonstrators.	21	22*	21	8	23	6	14	7	Including 10 Demonstrators.
Bihar and Orissa.										
Vernacular Agricultural School, Pathra (Godda), District Santal Pargannas.	Rice—sowing, planting and threshing; trench digging; cotton, mustard and vegetables growing.	..	..	40	..	33	33	40	2	Attached to the C. M. S. Mission Upper Primary School. Intended for elder girls. It has no connection with the Agricultural Department.
United Provinces.										
Vernacular Agricultural School, Bulandshahr.	(1) Two-year Vernacular Course.	54	30	54	17	26	19	37	23	
	(2) Teachers' Training Class.	..	..		10	10	10	10	..	
	(3) Fieldmen's Course .	18	10		..	..	..	..	..	
	(4) Engine-drivers' Course.	13	5		..	..	..	..	..	
Central Provinces.										
Agricultural Middle School, Powarkhera.	Two-year Course .	38	26	36	3	..	23	22	8	
Burma.										
Agricultural School, Pyinmana.	Four-year Course .	..	14	64	..	..	..	61	..	The School is run by the American Baptist Mission and subsidized by Govt.
Central Farm School, Hmawbi.	(1) Horticultural Class	..	8	10	2	..	4	4	..	
	(2) Short Courses of practical instruction.	..	80	80	..	..	80	80	..	
Central Farm School, Mahlaing.	(1) One-year Course .	..	1	1	..	..	..	..	..	
	(2) Short Courses of practical instruction.	..	14	14	..	..	31	31	..	
Central Farm School, Tatkon	Short Courses of practical instruction.	..	5	5	..	..	..	..	..	
Central Farm School, Padu .	Ditto . .	..	9	9	..	..	..	..	..	
Central Farm School, Allanmyo	Ditto . .	..	18	18	..	..	..	..	..	

APPENDIX VII.

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1925-26.

The two tables below include Agricultural Societies for—

A. 1. *Purchase and Purchase and Sale.* These are societies intended to facilitate the purchase of agricultural requisites for members, such as societies which purchase seed, manure, implements, etc., for sale to their members. Societies of this character which collect for joint sale the produce of members without making this their main object are also included in this class.

2. *Production.* These are societies which have for their chief object an act of production without proposing to themselves sale as a direct object. These also include societies for joint irrigation, for collective use of machinery, for assistance in horse and cattle breeding, etc.

3. *Production and Sale.* This class includes societies in which these two functions are united or in which one or the other predominates, it being impossible to make a clear distinction between them. It covers all societies whose main object is the joint sale of any commodity whether such commodity is produced or worked up or prepared for sale by the society itself or by the members individually. It comprises all co-operative creameries and distilleries, as well as societies whose main object is the sale of grain, cattle, eggs, *ghi*, etc., produced by their members.

4. Other forms of co-operation except insurance.

B. Insurance.

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1925-26.

(A) PURCHASE, SALE AND PRODUCTION.

Province	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit and loss for the year	REMARKS
				Rs.	Rs.	Rs.	Rs.	
Bombay	Purchase, and Purchase and sale.	87	4,222	72,702	528	2,72,261	—29,073	
	Production	19	591	..	..	18,868	—10,364	
	Production and sale	78	11,094	2,27,620	16,08,978	16,75,145	+44,509	
	Others	69	16,232	15,341	4,139	2,03,944	+16,965	
	TOTAL	253	32,139	3,15,663	16,13,645	21,70,218	+22,037	
Madras	Purchase, and Purchase and sale.	98	8,948	1,74,669	8,061	5,38,613	—48,025	
	Production and sale	5	468	20,858	..	1,48,506	—9,569	
	Others	250	15,547	..	..	2,34,968	+4,009	
	TOTAL	353	24,963	1,95,527	8,061	9,22,087	—53,585	
Bengal.	Purchase, and Purchase and sale.	53	9,565	4,41,153	2,49,216	2,34,828	+15,282	
	Production	350	12,092	..	..	2,31,315	—25,070	
	Production and sale	78	7,377	10,20,386	7,34,656	5,72,834	+2,53,241	
	Others	22	8,249	27,231	20,391	31,024	+3,040	
	TOTAL	503	37,283	14,88,770	10,04,263	10,70,001	+2,46,493	

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1925-26—contd.

(A) PURCHASE, SALE AND PRODUCTION—*contd.*

Province	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit and loss for the year	REMARKS
				Rs.	Rs.	Rs.	Rs.	
Bihar and Orissa ..	Purchase and sale . .	9	394	10,713	..	16,782	+1,995	
	Production and sale . .	19	258	304	1,678	15,462	—3,757	
	Others (grain golas) . .	84	22,410	..	..	1,34,124*	+1,022†	* and 66,185 md. of grain. † and profit of 8,657 md. of grain.
	TOTAL .	112	23,062	11,017	1,678	1,66,368	—740	
United Provinces .	Purchase and sale . .	1	72	..	..	6,793	23	
	Production and sale . .	3	75	2,369	2,076	11,677	567	
	Others	1	12	..	..	..	..	
	TOTAL .	5	159	2,369	2,076	18,470	590	
Punjab . .	Purchase, and Purchase and sale.	12	740	92,057	91,170	11,139	+10,595	
	Production . . .	168	3,450	..	..	4,999	+1,038	
	Production and sale . .	71	2,866	23,62,521	38,49,220	5,08,584	+12,445	
	Others	250	11,131	..	50	30,098	+3,103	
	TOTAL .	501	18,187	24,54,578	39,40,440	5,54,820	+27,181	

Burma . . .	Purchase, and Purchase and sale.	21	1,459	38,370	37,140	55,214	—3,507
	Production . . .	6	180	..	..	..	..
	Production and sale . .	62	5,521	37,089	9,065	5,22,891	—16,471
	TOTAL .	89	7,160	75,459	46,205	5,78,105	—19,978
Central Provinces and Berar.	Purchase and sale . .	9	894	26,000	214	62,041	—2,407
	Production . . .	9	95	..	2,912	951	..
	Production and sale . .	1	219	2,740	..	10,781	+458
	TOTAL .	19	1,208	28,740	3,126	73,773	—1,949

(B) CATTLE INSURANCE.

Province	Number of societies	Amount of risk insured	Premia collected during the year	Supplementary contributions collected	NUMBER OF ANIMALS		Claims paid	Cost of management	Funds in hand at end of year	Amount of risk re-insured	Amount of premia paid for re-insurance
					Insured	Lost					
		Rs.	Rs.				Rs.	Rs.	Rs.	Rs.	Rs.
Bombay . . .	9	725	36	..	12	..	..	83	1,292	..	..
Madras . . .	3	..	..	..	..	..	..	16	42	..	..
Burma . .	395	36,125	1,438	..	803	23	1,618	132	37,238	14,895	614
	1*	14,895	690	..	863	46	753	1,269	15,540	..	..

* Central Re-insurance Society.

APPENDIX VIII.

Showing the working of the Provincial Veterinary Departments during 1925-26.

Province	Reported mortality from contagious diseases			Dispensaries and Hospitals			District work					
	Rinderpest	Other diseases	Total	Number of institutions	Cases treated	Castrations performed	Cases treated	Castrations performed	Outbreaks in which inoculation was undertaken	Deaths uninoculated	Inoculations	Deaths after inoculation
Bombay	23,045	3,089	26,734	96	164,046	8,710	33,321	9,185	887	13,729	98,877	220
Madras	23,724	21,514	45,238	82	110,057	3,103	53,545	6,430	871	17,363	175,302	784
Bengal	24,695	8,529	33,224	43	63,013	103	100,791	39	966	22,034	175,096	972
Bihar and Orissa	10,384	6,065	16,449	30	45,651	1,100	81,279	587	1,035	6,003	170,153	485
United Provinces	24,778	15,960	40,738	138	242,910	2,478	99,595	430	1,153	16,019	145,956	241
Punjab	52,269	19,566	71,835	191	703,341	75,802	120,502	107,196	2,202	17,693	493,101	353
Burma	44,583	5,206	49,789	5	12,075	11	149,442	..	743	6,589	79,922	498
Central Provinces	38,685	7,580	46,265	89	289,065	3,392	347,888	35,842	1,498	11,761	152,228	259
Assam	31,799	24,828	56,627	3	4,819	122	70,312	1,162	540	13,405	43,912	757
North-West Frontier Province	2,191	1,388	3,579	16	54,076	4,411	27,156	22,415	38	617	8,314	5
Sind	579	2,364	2,943	16	34,244	129	7,228	58	29	339	5,652	24
Baluchistan	4	5,702	5,706	9	16,418	100	6,475	10	6	907	1,069	5
Rajputana	595	123	718	2	2,333	11	106	..	4	319	617	..
TOTAL FOR 1925-26	277,931	121,914	399,845	720	1,742,048	99,472	1,097,640	183,354	10,082	126,778	1,550,199	4,603
TOTAL FOR 1924-25	170,029	96,448	266,477	683	1,582,418	74,622	1,062,276	120,805	7,112	82,517	968,431	2,711

APPENDIX IX.

Showing the details as to students of Veterinary Colleges and Schools in India during 1925-26.

Veterinary College or School	Course of instruction	Number of Students						Students admitted during the year, classed by educational qualifications		
		Admitted during the year		Passed final examination during the year	Failed to pass final examination	Remaining under instruction at end of the year		Matriculates, School finals or with higher qualifications	Knowing some English but not matriculates	Knowing no English or very little English
		Scholarship holders	Others			In ordinary course	Instruction prolonged by reason of failure to pass			
Bombay Veterinary College	3 years' English Course.	8	30	13	5	71	11	14	24	..
Bengal „ „	Do.	15	11	22	12	60	18	20	6	..
Madras „ „	Do.	15	7	15	5	31	14	22	..	..
	Post Diploma Course.	8	..	8	..	..	..	8	..	..
Punjab „ „	4 years' English Course.	14	35	6	3	44	52	49	..	..
	Post Diploma Course.	9	..	..	..	9	..	..	..	..
Insein „ School	3 years' Vernacular Course.	..	..	13	..	28	..	..	..	..
Taunggyi „ „	1½ years' Vernacular Course.	4	5	2	..	9	..	..	..	..

APPENDIX X.

Showing the number of cattle issued from Government farms during 1925-26.

Province	Bulls	Cows	Male buffaloes	She buffaloes	Young stock	Total for 1925-26	Total for 1924-25	Remarks
Bombay	27	28	..	..	32	87	176	
Madras	6	6	..	..	9	21	34	
Bengal	7	23	..	..	32	62	..	
Bihar and Orissa	21	..	..	..	..	21	16	
United Provinces	99	..	1	..	..	100	79	
Punjab	422	10	..	..	328	760	440	
Burma	3	9	..	..	13	25	2	
Central Provinces	59	118	24	21	52	274	269	
Assam	9	4	..	..	7	20	19	
North-West Frontier Province	..	..	..	..	..	..	2	
Imperial Farms.								
Pusa	5	41	..	..	64	110	129	
Karnal	..	3	..	..	1	4	..	
Bangalore	2	28	..	..	41	71	85	
Wellington	1	2	..	..	39	42	43	

APPENDIX XI.

List of Agricultural Publications in India during 1925-26.

No.	Title	Author	Where published
	GENERAL AGRICULTURE		
1	The *Agricultural Journal of India*, Vol. XX, Parts IV, V and VI, and Vol. XXI, Parts I, II and III. Price, Re. 1-8 or 2*s.* per part; annual subscription Rs. 6 or 9*s.* 6*d.*	Edited by the Agricultural Adviser to the Government of India, Pusa.	Government of India Central Publication Branch, Calcutta.
2	Scientific Reports of the Agricultural Research Institute, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugarcane Expert, and Secretary, Sugar Bureau) for 1924-25. Price, Rs. 2-4 or 4*s.*	Issued from the Agricultural Research Institute, Pusa.	Ditto.
3	Guide to the Agricultural Research Institute, Pusa.	Issued by the Director, Agricultural Research Institute, Pusa.	Ditto.
4	Review of Agricultural Operations in India, 1924-25. Price, Rs. 2-2 or 4*s.*	Issued by the Agricultural Adviser to the Government of India.	Ditto.
5	Proceedings of the Board of Agriculture in India, held at Pusa on 7th December, 1925, and following days (with appendices). Price, Re. 1-14 or 3*s.* 3*d.*	Ditto . .	Ditto.
6	Results of Spinning Tests on Standard Indian Cottons.	Issued by Indian Central Cotton Committee Technological Laboratory.	G. Claridge & Co., Ltd., Caxton Works, Bombay.
7	Comparative Spinning Tests on Machine-ginned and Saw-ginned Cotton—Punjab-American Type 289 F.	Ditto. . .	Ditto.
8	Some Modern Problems of Scientific Research for the improvement of Cotton Growing.	Issued by the Indian Central Cotton Committee.	The Times Press, Bombay.
9	Administration Report of the Indian Meteorological Department for the year 1924-25 and a History of the Department during the half-century 1875-1924.	Director-General of Observatories.	Government of India Press, Simla.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
10	Estimates of Area and Yield of Principal Crops in India, 1924-25. Price As. 12 or 1*s*.	Issued by the Department of Commercial Intelligence and Statistics, India.	Government of India Central Publication Branch, Calcutta.
11	Agricultural Statistics of India, 1923-24. Vol. I, Price Re. 1; Vol. II, Price Re. 1.	Ditto . .	Ditto.
12	Statistical Abstract for British India with statistics, where available, relating to certain Indian States, 1915-16 to 1924-25. Price, Rs. 2 or 3s. 9d.	Ditto . .	Ditto.
13	A Note on the Growing of Green Manure Crops. Madras Department of Agriculture Leaflet 41. (Tamil only.)	N. S. Kulandaiswami Pillai, Assistant Director of Agriculture Madras.	Government Press, Madras.
14	Note on Ensilage. Madras Department of Agriculture Leaflet 43. (English, Tamil, Telugu, Malayalam and Kanarese.)	R. W. Littlewood, N.D.A., Deputy Director of Agriculture, Live Stock, Madras.	Ditto.
15	Report on the Operations of the Department of Agriculture, Madras Presidency, for the official year 1924-25.	Issued by the Department of Agriculture, Madras.	Ditto.
16	Season and Crop Report of the Madras Presidency for the Agricultural year 1924-25 (*Fusli* 1334). Price, Rs. 2-8.	Ditto . .	Ditto.
17	Villagers' Calendar, 1926 .	Ditto . .	Ditto.
18	Sugarcane varieties of the Bombay Presidency, India. Bombay Department of Agriculture Bulletin 122.	Issued by the Department of Agriculture, Bombay.	Yeravada Prison Press, Poona.
19	Ridge Cultivation in Lower Gujarat. Bombay Department of Agriculture Bulletin 123.	Ditto . .	Ditto.
20	The Bhagnari Breed of Cattle in Sind and Baluchistan. Bombay Department of Agriculture Bulletin 126. Price, As. 6.	H. G. Baluch, B.Ag., Officiating Live Stock Expert to Government, Bombay.	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
21	Elephant Grass. Bombay Department of Agriculture Bulletin 127. Price, Anna 1.	Harold H. Mann, D.Sc., Director of Agriculture, Bombay.	Yeravada Prison Press, Poona.
22	Cotton Cultivation in Sind. Bombay Department of Agriculture Bulletin 128. Price, As. 3.	Khan Bahadur Gul Mohamed Abdur Rehman, Officiating Deputy Director of Agriculture, Sind.	Ditto.
23	Use of Wire for preventing lodging of Sugarcane in Konkan. Bombay Department of Agriculture Leaflet 1 of 1925.	Issued by the Department of Agriculture, Bombay.	Ditto.
24	Hints to Sann-hemp Growers in Panchmahals. Bombay Department of Agriculture Leaflet 2 of 1925.	Ditto . .	Ditto.
25	Vernacular Agricultural School at Devi-Hosur. Bombay Department of Agriculture Leaflet 1 of 1926.	Ditto . .	Ditto.
26	Manuring of Sugarcane. Bombay Department of Agriculture Leaflet 2 of 1926.	Ditto . .	Ditto.
27	Preliminary Instructions in Cultivation of Cotton on the Deccan Canals. Bombay Department of Agriculture Leaflet 3 of 1926.	Ditto . .	Ditto.
28	New type of Tobacco Seed, No. 6. Bombay Department of Agriculture Leaflet 5 of 1926.	Ditto . .	Ditto.
29	List of Implements recommended by the Agricultural Department for the Deccan and Karnatak Districts. Bombay Department of Agriculture Leaflet 6 of 1926.	Ditto . .	Ditto.
30	Season and Crop Report of the Bombay Presidency for 1924-25.	Ditto . .	Ditto.
31	Annual Report of the Department of Agriculture in the Bombay Presidency, 1924-25. Price, Rs. 2-2.	Ditto . .	Government Central Press, Bombay.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
32	Annual Report of the Department of Agriculture, Bengal, 1924-25. Price, Re. 5.	Issued by the Department of Agriculture, Bengal.	Bengal Secretariat Book Depôt, Calcutta.
33	Activities of the Department of Agriculture, Bengal. (English and Bengali.)	Rai Sahib D. N. Mitra, L.Ag., District Agricultural Officer, Faridpur, Bengal.	Ditto.
34	Season and Crop Report of Bengal, 1925-26. Price, Re. 1-8.	Issued by the Department of Agriculture, Bengal.	Ditto.
35	Improved Cattle for Bengal. Bengal Department of Agriculture Leaflets Nos. 6 and 7. (English and Bengali.)	Ditto	Ditto.
36	Annual Report of the Department of Agriculture, Bihar and Orissa, for 1924-25.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Press, Bihar and Orissa, Gulzarbagh.
37	Agricultural Statistics of Bihar and Orissa for 1924-25.	Ditto	Ditto.
38	Season and Crop Report, Bihar and Orissa, 1925-26.	Ditto	Ditto.
39	Annual Report on the Administration of the Department of Agriculture, United Provinces, for the year ending 30th June 1925.	Issued by the Department of Agriculture, United Provinces.	Government Press, United Provinces, Allahabad.
40	Report on the Agricultural Stations of Central Circle, United Provinces, for the year 1924-25.	Ditto.	Ditto.
41	Report on the Agricultural Stations of Western Circle, United Provinces, for the year ending 31st May, 1925.	Ditto	Ditto.
42	Combined Report on the Experimental Stations in the Eastern Circle, United Provinces, for the year ending 31st May, 1925.	Ditto	Ditto.
43	Report on Agricultural Stations of the North-Eastern Circle, United Provinces, for the year 1924-25.	Ditto	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
44	Report on the Agricultural Stations in the Rohilkhand Circle, United Provinces, for the year ending 31st May, 1925.	Issued by the Department of Agriculture, United Provinces.	Government Press, United Provinces, Allahabad.
45	Present Position of Cotton in the unirrigated tracts of United Provinces.	B. Ram Prasad, Assistant Economic Botanist to Government, United Provinces.	Ditto.
46	Note on Barley in United Provinces.	Ditto . .	Ditto.
47	Report on the Working and Administration of United Provinces Government Gardens for the year 1924-25.	Issued by the Department of Agriculture, United Provinces.	Ditto.
48	Sheep-Breeding Experiments in the United Provinces by the Civil Veterinary Department during the years 1912 to 1923.	Captain S. G. M. Hickey, M.R.C.V.S., Veterinary Adviser to Government, United Provinces.	Ditto.
49	Season and Crop Report of the United Provinces of Agra and Oudh for the year 1924-25. Price, As. 14.	Issued by the Department of Land Records, United Provinces.	Ditto.
50	Annual Report on the Operations of the Department of Agriculture, Punjab, for the year ending 30th June 1924, Part II, Vols. I and II (Annual Record of Experimental work). Price, Rs. 11.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
51	Report on the Operations of the Department of Agriculture, Punjab, 1924-25. Part I, Price, Rs. 3-8.	Ditto . .	Ditto.
52	Seasonal Notes, October 1925. Price, As. 3.	Ditto. . .	Ditto.
53	Seasonal Notes, April 1926. Price, As. 3.	Ditto . .	Ditto.
54	Report on the Lawrence Gardens for the year 1924-25. Price, As. 8.	Ditto . .	Ditto.
55	Prospectus of the Punjab Agricultural College, Lyallpur, 1926.	Ditto . .	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE—*con'd.*		
56	Season and Crops of the Punjab for the year 1924-25. Price, Rs. 3 or 4*s*.	Issued by the Department of Land Records, Punjab.	Government Printing, Punjab, Lahore.
57	Tables of Agricultural Statistics for 1924-25 of the Punjab Department of Agriculture.	Issued by the Department of Agriculture, Punjab.	Ditto.
58	List of dates of Horse and Cattle Fairs in the Punjab, 1925-26.	Ditto . .	Ditto.
59	Results of Trials of Chattonooga No. 44 Power Crusher at Gurdaspur. Punjab Department of Agriculture Leaflet 33.	Ditto . .	Ditto.
60	Some Hints on Potato Cultivation in the Punjab Plains. Punjab Department of Agriculture Leaflet 35.	Ditto . .	Ditto.
61	Broom-rape and its eradication. Punjab Department of Agriculture Leaflet 38.	Ditto . .	Ditto.
62	Rates of Food Consumption by Zemindars in the Tallaganj Tahsil of the Attock District. Punjab Board of Economic Enquiry, Rural Section Publication 6. Price, As. 6.	C. B. Barry, M.A., I.C.S., Settlement Officer, Attock.	Civil and Military Gazette Press, Lahore.
63	Sixty years of Punjab Food Prices, 1861-1920. Punjab Board of Economic Enquiry, Rural Section Publication 7. Price, As. 10.	W. H. Myles, M.A., Professor of Economics, Punjab University.	Ditto.
64	Report on the working of the Department of Agriculture, Central Provinces, for 1924-25.	F. J. Plymen, A. C. G. I., Director of Agriculture, Central Provinces and Berar.	Government Press, Central Provinces, Nagpur.
65	Report on the Agricultural Stations in the Northern Circle, Central Provinces, for the year 1923-24. Price, Rs. 2.	J. H. Ritchie, M.A., B.Sc., Deputy Director of Agriculture, Northern Circle, Jubbulpore.	Ditto.
66	Report on the Agricultural Stations in the Southern Circle, Central Provinces, 1924-25. Price, Re. 1-4.	G. K. Kelkar, B.A., Deputy Director of Agriculture in charge, Southern Circle, Central Provinces.	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
67	Report on the Demonstration Work carried out in the Southern Circle, Central Provinces, 1924-25. Price, As. 8.	G. K. Keller, B.A., Deputy Director of Agriculture in charge, Southern Circle; and T. K. Ghatpande, Extra Assistant Director of Agriculture, Central Provinces.	Government Press, Central Provinces, Nagpur.
68	Report on the Agricultural Stations in the Eastern Circle, Central Provinces, 1924-25. Price, Rs. 2.	Rao Bahadur T. L. Powar, B. A., Officiating Deputy Director of Agriculture, Eastern Circle, Central Provinces.	Ditto.
69	Report on the Demonstration Work carried out in the Eastern Circle, Central Provinces, 1924-25. Price, As. 5.	Nand Kishore, L.Ag., Extra Assistant Director; and Rao Bahadur T. L. Powar, B.A., Officiating Deputy Director of Agriculture, Eastern Circle, Central Provinces.	Ditto.
70	Report on the Agricultural Stations in the Western Circle, Central Provinces, 1924-25. Price, Re. 1-8.	S. G. Mutkekar, B.Ag., M.Sc., Deputy Director of Agriculture, Western Circle; and W. Youngman, B.Sc., Economic Botanist for Cotton, Central Provinces.	Ditto.
71	Report on the Demonstration Work carried out in the Western Circle, Central Provinces, 1924-25. Price, Re. 1-13.	S. G. Mutkekar, B.Ag., M.Sc., Deputy Director of Agriculture, Western Circle, Central Provinces.	Ditto.
72	Report on the Agricultural Stations in the Northern Circle, Central Provinces, 1924-25. Price, Rs. 4-8.	J. H. Ritchie, M.A., B. Sc., Deputy Director of Agriculture; and E. A. H. Churchill, B.Sc., Assistant Director of Agriculture, Northern Circle, Central Provinces.	Ditto.
73	Report on the Demonstration Work carried out in the Northern Circle, Central Provinces, 1924-25. Price, Re. 1.	Rao Sahib B. L. Dubey and Govind Prasad, Extra Assistant Directors of Agriculture, Central Provinces.	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
74	Report on the Agricultural College, Nagpur, Chemical, Botanical, Mycological, Entomological Research, Agricultural Engineer's Section and Maharajbagh Menagerie, 1924-25. Price, Re. 1-2.	R. G. Allan, M.A., Principal, Agricultural College; H. E. Annett, D.Sc., Agricultural Chemist; W. Youngman. B.Sc., Economic Botanist for Cotton: J. F. Dastur, M.Sc., Mycologist; J. L. Khare, L.Ag., Entomological Assistant; H. Copley, Agricultural Engineer, Nagpur.	Government Press, Central Provinces, Nagpur.
75	Report on the Experimental Farm attached to the Agricultural College, Nagpur, 1924-25. Price, Re. 1-12.	R. G. Allan, M.A., Principal, Agricultural College, Nagpur.	Ditto.
76	Report on the Cattle-breeding Operations in the Central Provinces and Berar, 1924-25. Price, As. 9.	S. T. D. Wallace, B.Sc., Deputy Director of Animal Husbandry, Central Provinces.	Ditto.
77	Comments on the Return of Expenditure of the Provincial and District Gardens in the Central Provinces and Berar for the year ending the 31st March, 1925.	Issued by the Department of Agriculture, Central Provinces.	Ditto.
78	Sugarcane Cultivation. Central Provinces Department of Agriculture Bulletin 21.	G. K. Kelkar, B. A., Extra Assistant Director of Agriculture, Central Provinces.	Ditto.
79	Season and Crop Report of the Central Provinces and Berar for the year 1924-25. Price, Rs. 3-8.	Issued by the Department of Land Records, Central Provinces.	Ditto.
80	Report on the Operations of the Department of Agriculture, Burma, for the year ended 30th June, 1925.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
81	Report on the Mandalay Agricultural Station for the year ended 30th June, 1925.	Ditto . .	Ditto.
82	Report on the Padu Agricultural Station for the year ended 30th June, 1925.	Ditto . .	Ditto.
83	Report on the Tatkon Agricultural Station for the year ended 30th June, 1925.	Ditto . .	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
84	Report on the Yawnghwe Agricultural Station for the year ended 30th June, 1925.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
85	Report on the Mahlaing Agricultural Station for the year ended 30th June, 1925.	Ditto . .	Ditto.
86	Report on the Allanmyo and Pwinbyu Seed Farm for the year ended 30th June, 1925.	Ditto . .	Ditto.
87	Report on the Akyab Agricultural Station for the year ended 30th June, 1925.	Ditto . .	Ditto.
88	Report on the Hmawbi Agricultural Station for the year ended 30th June, 1925.	Ditto . .	Ditto.
89	Annual Report of the Agricultural Engineer, Burma, 1924-25.	Ditto . .	Ditto.
90	Report of the Principal, Agricultural College and Research Institute, Mandalay, 1924-25.	Ditto . .	Ditto.
91	Agricultural Statistics of Burma for the year 1924-25. Price, Re. 1-8 or 2*s.* 3*d.*	Published by Commissioner of Settlements and Land Records, Burma.	Ditto.
92	Season and Crop Report of Burma for the year ending the 30th June 1925. Price, Re 1 or 1*s.* 6*d.*	Ditto . . .	Ditto.
93	Agricultural Calendar, Burma, 1926-27. (Burmese.)	Issued by the Department of Agriculture, Burma.	Ditto.
94	Economic Survey of the Sugarcane Industry in the East Central, Tenasserim and Northern Agricultural Circles, Burma. Burma Department of Agriculture Bulletin 23.	Ditto . .	Ditto.
95	Report of the Agricultural Department, Assam, for the year ending 31st March, 1925.	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
96	Tables of the Agricultural Statistics of Assam for the year 1924-25.	Ditto . .	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*con'd.*		
97	Practical Suggestions to Orange Growers.	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
98	Report of the Agricultural Stations at Tarnab and Haripur in the North-West Frontier Province, 1924-25. Price, As. 7.	W. Robertson Brown, Agricultural Officer, North-West Frontier Province.	North-West Frontier Province Government Printing and Stationery Office, Peshawar.
99	Summary of Remarks on the Kharif Crop of the North-West Frontier Province for 1925-26. Price, As. 6.	Revenue Commissioner, North-West Frontier Province.	Ditto.
100	Report on the Season and Crops of the North-West Frontier Province for the year 1924-25. Price, Re. 1-7 or 2*s.* 5*d.*	Ditto . .	Ditto.
101	Report on the Administration of the Village Panchayats and Department of Agriculture in the Cochin State for the year 1924-25.	Superintendent of Agriculture and Panchayats, Trichur.	Government Press, Cochin, Ernakulam.
102	Annual Report of the Departments of Agriculture and Agricultural Engineering, Gwalior Government, 1924-25.	Issued by the Department of Agriculture, Gwalior.	Alijah Darbar Press, Lashkar.
103	Annual Report of the Agricultural Department, Mysore, for the year 1924-25.	Issued by the Department of Agriculture, Mysore.	Government Press, Bangalore.
104	Report on the working of the Amrit Mahal Department, Mysore, 1924-25.	Ditto . .	Ditto.
105	Mysore Agricultural Calendar, 1926. Price, As. 2.	Ditto . .	Ditto.
106	A Note on the Consolidation of Holdings in Mysore.	A. K. Yegna Narayan Iyer, M.A., Dip. Agri., N.D.D., F.C.S., Deputy Director of Agriculture, Mysore State.	Ditto.
107	Annual Report of the Department of Agriculture, Baroda State, for the year 1923-24. Price, Re. 1-7.	Issued by the Department of Agriculture, Baroda.	Baroda State Press, Baroda.
108	*Journal of the Mysore Agricultural and Experimental Union* (Quarterly). Annual subscription Rs. 3.	Mysore Agricultural and Experimental Union.	Bangalore Press, Bangalore.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*concld.*		
109	*Rural India* (Monthly). Annual subscription, Rs. 3.	A. Swaminatha Aiyar, Editor.	Forest Panchayet Banking Union, Madras.
110	The *Journal of the Madras Agricultural Students' Union* (Monthly). Annual subscription Rs. 4 ; single copy, As. 6.	Madras Agricultural Students' Union, Coimbatore.	The Electric Printing Works, Coimbatore.
111	The *Planters' Chronicle* (Weekly). Price, As. 8 per copy.	United Planters' Association of South India, Coimbatore.	Ditto
112	The *Allahabad Farmer* (Quarterly). Single copy, As. 8 ; annual subscription, Rs. 2.	W. B. Hayes, A. Sinha and N. R. Joshi, Editors.	The Mission Press, Allahabad.
113	The *Old Boys Magazine, Agricultural College, Cawnpore* (Quarterly). Price per copy, As. 8 ; Annual subscription, Rs. 2.	M. L. Saksena, L.Ag., Editor.	Cawnpore Printing Press.
114	*Nagpur Agricultural College Magazine* (Quarterly). Annual subscription, Rs. 3.	R. A. Ramayya and R. B. Ekbote, Editors.	Udyama Desh Sevak Press, Nagpur.
115	The *Bengal Agricultural Journal* (Quarterly). (In English and Bengali.) Annual subscription, Re. 1-4 ; single copy, As. 5.	Issued by the Department of Agriculture, Bengal.	Sreenath Press, Dacca.
116	*Quarterly Journal of the Indian Tea Association.* Price, As. 6 per copy.	Issued by the Scientific Department of the Indian Tea Association, Calcutta.	Catholic Orphan Press, Calcutta.
117	*Indian Scientific Agriculturist* (Monthly). Annual subscription, Rs. 4.	H. C. Sturgess, Editor ; J. W. Mackay, Consulting Editor.	Calcutta Chromotype Company, Calcutta.
118	*Rural Bengal* (Monthly) . .	N. N. Gupta, B.A., PH.D., B.SC., Editor.	Sreemat Bhagabat Press, Bhawanipur, Calcutta.
119	*Krishak* (Bengali) (Monthly). Price, As. 5 per copy ; Annual subscription, Rs. 3-3.	U. C. Bannerji, Editor .	Sri Ram Press, 162, Bowbazar Street, Calcutta.
120	*Poona Agricultural College Magazine* (Quarterly). Annual subscription, Rs. 2-8 ; single copy, As. 10.	College Magazine Committee, Poona.	Agricultural College, Poona.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	AGRICULTURAL CHEMISTRY		
121	The Quality and Yield of Tobacco as influenced by Manurial and other Operations. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 1. Price, As. 8 or 9*d*.	J. N. Mukherji, B.A., B.Sc., First Assistant to Imperial Agricultural Chemist.	Government of India Central Publication Branch, Calcutta.
122	Investigations on Indian Opium, No. 4—Further Experiments on the influence of Manures on the Yield and Morphine content of the Latex of the Opium Poppy.	Harold E. Annett, D.Sc., F.I.C., M.S.E.A.C., and Har Dayal Singh, B.Sc.	Ditto.
	No. 5—Experiments on oil content of the seed of the Opium Poppy; and No. 6—Studies on the Ash constituents of Indian Opium. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, Nos. 2-4. Price, As. 8 or 10*d*.	Harold E. Annett, D.Sc., F.I.C., M.S.E.A.C., and M. N. Bose, M.A.	Ditto.
123	Nitrogen Recuperation in the Soils of the Bombay Deccan. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 5. Price, As. 4 or 5*d*.	D. L. Sahasrabuddhe, M.Ag., M.Sc., and J. A. Daji, B.Ag., B.Sc.	Ditto.
124	Determination of available Phosphoric Acid of Calcareous Soils. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 6. Price As. 12 or 1*s*. 3*d*.	Surendralal Das, M.Sc., Assistant to the Imperial Agricultural Chemist.	Ditto.
125	Deterioration of Sugarcane during its storage by Windrowing. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 7. Price, As. 6 or 8*d*.	Phani Bhusan Sanyal, M.Sc., Assistant to the Imperial Agricultural Chemist.	Ditto.
126	Drainage Waters at Cawnpore. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 8. Price, As. 10 or 1*s*.	H. N. Batham, M.A., F.I.C.S., Agricultural Chemist to the Government of United Provinces.	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	AGRICULTURAL CHEMISTRY —*concld.*		
127	Nutrients required for Milk Production with Indian Foodstuffs. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 9. Price, As. 14 or 1*s.* 6*d.*	F. J. Warth, M.Sc., Physiological Chemist, Bangalore; Labh Singh, L.Ag., B.Sc. (Agri.); and S. M. Hussain, B.Sc.	Government of India Central Publication Branch, Calcutta.
128	Silage Experiments at Nagpur. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 10. Price, As. 10 or 1*s.*	Harold E. Annett, D.Sc., F.I.C., M.S.E.A.C., Agricultural Chemist to the Government of Central Provinces; and A. R. Padmanabha Aiyer, B.A.	Ditto.
129	Nutrients required for Growth Production with Indian Foodstuffs. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 11. Price, As. 3 or 4*d.*	F. J. Warth, M.Sc., Physiological Chemist, Bangalore; and Izaz Ahmad, B.Sc. (Agri.).	Ditto.
130	Standard Methods of Analysis of Fertilizers. Pusa Agricultural Research Institute Bulletin 164. Price, As. 4 or 6*d.*	J. Sen, M.A., Ph.D., Officiating Imperial Agricultural Chemist.	Ditto.
131	Annual Report of the Agricultural Chemist, Burma, for the year ended 30th June 1925.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
132	The Chemical Composition of the Food Grains, Vegetables and Fruits of Western India. Bombay Department of Agriculture Bulletin 124. Price, As. 3-6.	D. L. Sahasrabuddhe, M.Sc., M.Ag., Agricultural Chemist to Government, Poona.	Yeravada Printing Press, Poona.
	BOTANY.		
133	A Study of some Indian Grasses and Grasslands. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIV, No. 1. Price, As. 12 or 1*s.* 3*d.*	W. Burns, D.Sc., L. B. Kulkarni, M.Ag., and S. R. Godbole, B.Ag., B.Sc.	Government of India Central Publication Branch, Calcutta.
134	Annual Report of the Economic Botanist, Burma, for the year ended 30th June 1925.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	BOTANY—*concld.*		
135	Studies in Gujarat Cottons, Part III. The Wagad Cotton of Upper Gujarat, Kathiawad and Kutch. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIV, No. 2. Price, Re. 1-4 or 2*s.* 3*d.*	Maganlal L. Patel, M.Ag., and D. P. Mankad, Cotton Breeders, Gujarat.	Government of India Central Publication Branch, Calcutta.
	MYCOLOGY.		
136	Bordeaux or Burgundy Mixture as a preventive to Potato disease (*Phytophthora*) (in English).	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
137	Annual Report of the Mycologist, Burma, for the year ended 30th June, 1925.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
138	The Diseases of Para Rubber in Burma. Burma Department of Agriculture Bulletin 14.	Ditto	Ditto.
139	The Diseases of Rubber in Burma (Burmese). Burma Department of Agriculture Cultivators' Leaflet 54.	Ditto	Ditto.
	ENTOMOLOGY.		
140	A Contribution towards a Monograph of the Indian Coniopterygidæ (Neuroptera).	C. L. Withycombe, Ph.D., M.Sc., D.I.C.	Government of India Central Publication Branch, Calcutta.
141	The Bionomics and Life-histories of some of the Common Tabanidæ of Pusa ; and Some Observations on the Life-history and Habits of *Phycus brunneus*, Wied. (Family Therevidæ). Memoirs of the Department of Agriculture in India, Entomological Series, Vol. IX, Nos. 1-3. Price, Rs. 2-2 or 4*s.*	P. V. Isaac, B.A., M.Sc., D.I.C., F.E.S., Second Entomologist (Dipterist), Pusa.	Ditto.
142	The Red Pumpkin Beetle (*Aulacophora abdominalis*, Fb.) and its Control ; with a short Note on *A. atripennis*, Fb. Memoirs of the Department of Agriculture in India. Entomological Series, Vol. IX, No. 4. Price, Re. 1 or 1*s.* 9*d.*	M. Afzal Husain, M.Sc., M.A., Entomologist to the Government of Punjab ; and S. Abdullah Shah, L.Ag.	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	ENTOMOLOGY—*contd.*		
143	Experiments on the Transmission of Rinderpest by means of Insects. Memoirs of the Department of Agriculture in India. Entomological Series, Vol. IX, No. 5. Price, Rs. 2-4 or 4*s.* 2*d.*	S. K. Sen, B.Sc., F.E.S., Assistant to the Imperial Entomologist.	Government of India Central Publication Branch, Calcutta.
144	Bot Flies of the Punjab. Pusa Agricultural Research Institute Bulletin 160. Price, As. 14 or 1*s.* 6*d.*	H. E. Cross, M.R.C.V.S., D.V.H., A.Sc., Camel Specialist, Punjab.	Ditto.
145	Publications on Indian Entomology, 1924. Pusa Agricultural Research Institute Bulletin 161. Price, As. 8 or 9*d.*	Compiled by the Imperial Entomologist.	Ditto.
146	Tentative Keys to the Orders and Families of Indian Insects. Pusa Agricultural Research Institute Bulletin 162. Price, Re. 1-4 or 2*s.* 3*d.*	T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S., Imperial Entomologist.	Ditto.
147	Catalogue of Indian Insects. Part 10—Stephanidæ. Price, As. 5 or 6*d.*	G. R. Dutt, B.A., Personal Assistant to the Imperial Entomologist.	Ditto.
148	The Rice Hispa—A pest of paddy. Madras Department Agriculture Leaflet 1 (revised) (in English, Tamil, Kanarese and Malayalam).	Rao Sahib Y. Ramachandra Rao, Government Entomologist, Coimbatore.	Government Press, Madras.
149	Report on a tour to investigate the causes of failure of the Lac crop in the Mathurapur Zemindary in the Malda District. Bengal Department of Agriculture Bulletin 50 (in Bengal).	Issued by the Department of Agriculture, Bengal.	Bengal Government Press, Calcutta.
150	Annual Report of the Entomologist and Sericultural Work. Burma, for the year ended 30th June 1925.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
151	A Note on Katra (Hairy Caterpillars of *Amsacta* species). Punjab Department of Agriculture Leaflet 36.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
152	Attack of Sugarcane Borers and how to reduce them. Punjab Department of Agriculture Leaflet 37.	Ditto . .	Ditto.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	ENTOMOLOGY—*concld.*		
153	Lantana known as *Pang Phuli*. Punjab Department of Agriculture Leaflet 39.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
154	*Tela* (Aphis) on Orange. Punjab Department of Agriculture Leaflet 9.	Ditto . .	Ditto.
155	The *Katra* or Hairy Caterpillar of Gujarat. Bombay Department of Agriculture Leaflet 4 of 1926.	Issued by the Department of Agriculture, Bombay.	Yeravada Prison Press, Poona.
	BACTERIOLOGY.		
156	Loss of Sugar by inversion in Sugar Factories in Northern India and its prevention by Antiseptic Measures. Pusa Agricultural Research Institute Bulletin 163. Price, As. 2 or 3*d*.	C. M. Hutchinson, C.I.E., B.A., Imperial Agricultural Bacteriologist, and C. S. Ram Ayyar, B.A.	Government of India Central Publication Branch, Calcutta.
	VETERINARY.		
157	Annual Report of the Imperial Institute of Veterinary Research, Muktesar, 1924-25. Price, Re. 1-14 or 3*s*. 3*d*.	J. T. Edwards, B.Sc., M.R.C.V.S., Director.	Ditto.
158	Nasal Granuloma in Cattle. Memoirs of the Department of Agriculture in India, Veterinary Series, Vol. III, No. 6. Price, Re. 1 or 1*s*. 6*d*.	V. Krishnamurti Ayyar, I.V.S.	Ditto.
159	Foot and Mouth Disease. Madras Veterinary Department Leaflet VIII (English, Tamil, Telugu, Malayalam, Kanarese and Oriya).	D. A. D. Aitchison, M.R.C.V.S., Veterinary Advisor to the Government of Madras.	Govenment Press, Madras.
160	The *Indian Veterinary Journal* (Quarterly). Annual subscription, Rs. 4 for members of All-India Veterinary Association and students; Rs. 8 for others.	P. Srinivasa Rao, G.M.V.C., Editor.	Methodist Publishing House, Madras.
161	Annual Administration Report of the Civil Veterinary Department, Madras Presidency, for the year 1924-25.	Issued by the Civil Veterinary Department, Madras.	Government Press, Madras.

List of Agricultural Publications in India during 1925-26—contd.

No.	Title	Author	Where published
	VETERINARY—*contd.*		
162	Annual Administrative Reports of the Bombay Veterinary College, Glanders and Farcy Department and Civil Veterinary Department in the Bombay Presidency (including Sind) for the year 1924-25.	Issued by the Civil Veterinary Department, Bombay.	Government Central Press, Bombay.
163	Skin Diseases of Dogs. Punjab Department of Agriculture Bulletin 15 (in Urdu).	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
164	A Further Note on Surra Transmission experiments with Ticks. Punjab Department of Agriculture Bulletin 8.	Ditto	Ditto.
165	Annual Report on the Punjab Veterinary College, Civil Veterinary Department, Punjab, and the Government Cattle Farm, Hissar, 1924-25. Price, Rs. 2-12.	Ditto	Ditto.
166	Annual Report of the Camel Specialist, Sohawa, for the year 1924-25. Price, As. 8.	Ditto	Ditto.
167	Prospectus of the Punjab Veterinary College, Lahore, 1926.	Ditto	Ditto.
168	Foot and Mouth Disease, Control by Chemotherapy. Punjab Veterinary Bulletin 17.	Col. G. K. Walker, C.B.E., C.I.E., F.R.C.V.S., and W. Taylor, M.R.C.V.S., Punjab Veterinary College.	Ditto.
169	Annual Report of the Civil Veterinary Department, Bihar and Orissa, for the year 1924-25. Price, Re. 1-4.	Issued by the Civil Veterinary Department, Bihar and Orissa.	Government Printing, Bihar and Orissa, Patna.
170	Annual Report of the Civil Veterinary Department, United Provinces, for the year ending 31st March 1925. Price, Re. 1-8.	Issued by the Civil Veterinary Department, United Provinces.	Government Press, United Provinces, Allahabad.
171	Report of the Civil Veterinary Department (including the Insein Veterinary School), Burma, for the year ending 31st March 1925. Price, Re. 1.	Issued by the Civil Veterinary Department, Burma.	Government Printing, Burma, Rangoon.

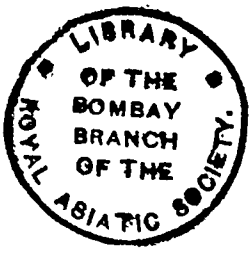
List of Agricultural Publications in India during 1925-26—concld.

No.	Title	Author	Where published
	VETERINARY—*concld.*		
172	Annual Report of the Bengal Veterinary College and Civil Veterinary Department, Bengal, 1924-25. Price, Re. 1 or 1*s.* 9*d.*	Issued by the Civil Veterinary Department, Bengal.	Bengal Government Press, Calcutta.
173	Report of the Civil Veterinary Department of the Central Provinces and Berar for the year 1924-25. Price, Re. 1.	Issued by the Civil Veterinary Department, Central Provinces and Berar.	Government Press, Central Provinces, Nagpur.
174	Report of the Civil Veterinary Department, Assam, for the year 1924-25. Price, As. 8 or 1*s.*	Issued by the Civil Veterinary Department, Assam.	Assam Secretariat Printing Office, Shillong.
175	Report of the Civil Veterinary Department, North-West Frontier Province, for the year 1924-25. Price, As. 15 or 1*s.* 1*d.*	Issued by the Civil Veterinary Department, North-West Frontier Province.	North-West Frontier Province Government Press, Peshawar.
176	Annual Report of the Civil Veterinary Department in Mysore, 1924-25.	Issued by the Department of Agriculture, Mysore State.	Government Press, Bangalore.
177	Annual Report on the working of the Government Stud Farm, Kunigal, for 1924-25, with the Government Review thereon.	Issued by the Department of Agriculture, Mysore.	Ditto.

MGIPC—M—IV-2-84—30-4-1927—850.

Review of Agricultural Operations in India

1926-27



BY

D. CLOUSTON, C.I.E., M.A., D.Sc.,
Agricultural Adviser to the Government of India

CALCUTTA: GOVERNMENT OF INDIA
CENTRAL PUBLICATION BRANCH
1928

Government of India Publications are obtainable from the Government of India Central Publication Branch, 3, Government Place, West, Calcutta, and from the following Agents :—

EUROPE.

OFFICE OF THE HIGH COMMISSIONER FOR INDIA,
42, GROSVENOR GARDENS, LONDON, S.W. 1.
And at all Booksellers.

INDIA AND CEYLON.

Provincial Book Depôts.

MADRAS :—Office of the Superintendent, Government Press, Mount Road, Madras.
BOMBAY :—Superintendent, Government Book Depôt, Town Hall, Bombay.
SIND :— Library attached to the Office of the Commissioner in Sind, Karachi.
BENGAL :—Office of the Bengal Secretariat Book Depôt, Writers' Buildings, Room No. 1, Ground Floor Calcutta.
UNITED PROVINCES OF AGRA AND OUDH :—Office of the Superintendent of Government Press, United Provinces of Agra and Oudh, Allahabad.
PUNJAB :—Office of the Supe intendent, Government Printing, Punjab, Lahore.
BURMA :—Office of the Superintendent, Government Printing, Burma, Rangoon.
CENTRAL PROVINCES AND BERAR :—Superintendent, Government Printing, Central Provinces, Nagpur.
ASSAM :—Office of the Superintendent, Assam Secretariat Press, Shillong.
BIHAR AND ORISSA :—Office of the Superintendent, Government Printing, Bihar and Orissa, P. O. Gulzarbagh, Patna.
COORG :—Office of the Chief Commissioner of Coorg, Bangalore.
NORTH-WEST FRONTIER PROVINCE :—Office of the Manager, Government Printing and Stationery, Peshawar.

Thacker, Spink & Co., Calcutta and Simla.
W. Newman & Co., Ltd., Calcutta.
R. Cambray & Co., Calcutta.
S. K. Lahiri & Co., Calcutta.
The Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta, and 226, Nawabpur, Dacca.
Butterworth & Co. (India), Ltd., Calcutta.
Rai M. C. Sarcar Bahadur & Sons, 90-2A, Harrison Road, Calcutta.
Standard Literature Company, Limited, Calcutta.
Association Press, Calcutta.
Chukervetty, Chatterjee & Co., Ltd., 13, College Square, Calcutta.
The Book Company, Calcutta.
James Murray & Co., 12, Government Place, Calcutta. (For Meteorological Publications only).
Ray Choudhury & Co., 68/5, Ashutosh Mukherji Road, Calcutta.
The Oriental Publishing House, 34, Cornwallis Street, Calcutta.
Scientific Publishing Co., 6 Taltolla Lane, Calcutta.
B, C. Basak, Esq., Proprietor, Albert Library, Dacca.
Mitra Brothers, Rajshahi.
Higginbothams, Madras.
P. R. Rama Iyer & Co., Madras.
Rochouse & Sons, Madras.
G. A. Natesan & Co., Publishers, George Town, Madras.
Theosophical Publishing House, Adyar, Madras.
Bright & Co., Trivandrum.
The Booklover's Resort, Trialkad, Trivandrum, South India.
E. M. Gopalakrishna Kone, Pudumandapam, Madura.
Vijapur & Co., Vizagapatam.
Thacker & Co., Ltd., Bombay.
D. B. Taraporevala, Sons & Co., Bombay.
Sunder Pandurang, Bombay.
Ram Chandra Govind & Sons, Kalbadevi Road, Bombay.
N. M. Tripathi & Co., Booksellers, Princes Street, Kalbadevi Road, Bombay.
Proprietor, New Kitabkhana, Poona.
The Manager, Oriental Book Supplying Agency, 15, Shukrawar, Poona City.
R. S. Gondhalekar's Book Depôt, Publisher and Bookseller, Budhwar Chawk, Poona City.
Rama Krishna Bros., Opposite Visrambag, Poona City.
Mangaldas & Sons, Booksellers and Publishers, Bhaga Talao, Surat.
Mrs. Radhabai Atmaram Sagoon, Kalbadevi Road, Bombay.
A. H. Wheeler & Co., Allahabad, Calcutta and Bombay.
R. B. Umadikar & Co., The Bharat Book Depôt, Dharwar.
The Standard Bookstall, Karachi, Quetta, Delhi, Murree and Rawalpindi.
The Karachi Book Depôt, Elphinstone Street, Camp, Karachi.
The English Bookstall, Karachi.
The Standard Bookstall, Quetta.
U. P. Malhotra & Co., Quetta.
J. Ray & Sons, 43, K. & L., Edwardes Road, Rawalpindi and Murree.
The Standard Book Depôt, Lahore, Nainital, Mussoorie, Dalhousie, Ambala Cantonment and Delhi.
N. B. Mathur, Supdt., Nazir Kanun Hind Press, Allahabad.
The North India Christian Tract and Book Society, 18, Clive Road, Allahabad.
Ram Dayal Agarwala, 184, Katra, Allahabad.
Manager, Newal Kishore Press, Lucknow.
The Upper India Publishing House, Ltd., 41, Aminabad Park, Lucknow.
Rai Sahib M. Gulab Singh & Sons, Mufid-i-Am Press, Lahore and Allahabad.
Rama Krishna & Sons, Booksellers, Anarkali, Lahore.
Puri Brothers, Booksellers and Publishers, Katcheri Road, Lahore.
The Tilak School Bookshop, Lahore.
The Standard Bookstall, Lahore.
The Proprietors, Punjab Sanskrit Book Depôt, Saidmitha Street, Lahore.
The Punjab Religious Book Society, Lahore.
The Insurance Publicity Co., Ld., Lahore.
Manager of the Imperial Book Depôt, 63, Chandni Chawk Street, Delhi.
Oxford Book and Stationery Company, Delhi.
Supdt., American Baptist Mission Press, Rangoon.
The Modern Publishing House, Ltd, 30, Phayre Street, Rangoon.
Burma Book Club, Ltd., Rangoon.
Manager, the "Hitavada," Nagpur.
Bhisey Brothers, Booksellers and Stationers, Sitabaldi, Nagpur.
S. C. Talukdar, Proprietor, Students & Co., Cooch Behar.
The Manager, Ceylon Observer, Colombo.
The Manager, The Indian Book Shop, Benares City.
The Srivilliputtur Co-operative Trading Union, Ltd., Srivilliputtur (Satur S.I.R.).
The Students' Emporium, Patna.
Raghunath Prasad & Sons, Patna City.
K. L. Mathur & Bros., Guzi, Patna City.
Dandekar Brothers, Indore City.
The Hyderabad Book Depôt, Chaderghat, Hyderabad (Deccan).
The Indian Army Book Depot, Jhûsi, Cawnpore.
Pustakalays Sahayak Sahakari Mandal, Ld., Baroda.

TABLE OF CONTENTS

	Page
Chapter I. Agricultural Conditions of the Year	1
Chapter II. Economic work on Crops—	
I. Rice	5
II. Wheat	10
III. Cotton	12
IV. Sugarcane	27
V. Jute	32
VI. Other fibres	34
VII. Tobacco	*ib*
VIII. Oil-seeds—	
Linseed	37
Mustard	*ib*
Sesamum	*ib*
Ground-nut	*ib*
Coconut	38
IX. Tea	39
X. Coffee	40
XI. Rubber	*ib*
XII. Fruit	41
XIII. Fodder crops and grasses	43
XIV. Millets	45
XV. Potatoes	46
XVI. Beans and pulses	47
Chapter III. Research and Investigation—	
I. Soils	49
II. Nitrogen fixation	51
III. Manures and fertilizers	52
IV. Animal nutrition	57
V. Sugarcane	58
VI. Milk and milk products	*ib*
VII. Diseases of crops	59
VIII. Insect pests	61
IX. Useful insects	62

PAGE

CHAPTER IV. AGRICULTURAL ENGINEERING—

(1) Well-boring 65
(2) Agricultural implements 66
(3) Motor tractors 67

CHAPTER V. DISTRICT WORK—

(1) Bombay 69
(2) Madras 70
(3) Bengal 71
(4) Bihar and Orissa . . . . . *ib*
(5) United Provinces 72
(6) Punjab . . . . . *ib*
(7) Central Provinces 73
(8) Burma . . . . . *ib*
(9) Assam 74
(10) North-West Frontier Province . . . . . *ib*
(11) Mysore . . . . . *ib*
(12) Travancore . . . . . *ib*
(13) Baroda . . . . . *ib*

CHAPTER VI. AGRICULTURAL EDUCATION—

I. Agricultural Colleges—

(1) Poona 75
(2) Coimbatore 76
(3) Lyallpur . . . . . *ib*
(4) Cawnpore . . . . . *ib*
(5) Nagpur . . . . . *ib*
(6) Mandalay . . . . . *ib*
(7) Pusa 77
(8) Bangalore . . . . . *ib*

II. Agricultural schools . . . . . *ib*
III. Short courses 80

CHAPTER VII. THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE—

(1) Bombay 83
(2) Madras 84
(3) Bengal . . . . . *ib*

PAGE

CHAPTER VII. THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE—*concld.*

(4) Bihar and Orissa 85
(5) United Provinces . . . . . *ib*
(6) Punjab . . . . . *ib*
(7) Central Provinces 86
(8) Burma . . . . . *ib*
(9) Assam 87
(10) Delhi . . . . . *ib*
(11) North-West Frontier Province . . . . . *ib*
Co-operative cotton sale societies . . . . . *ib*
Co-operative milk societies 88
Cattle insurance . . . . . *ib*

CHAPTER VIII. LIVE STOCK—

I. Prevention and treatment of disease 89
II. Incidence of disease 90
III. Preventive inoculation 91
IV. Veterinary education 93
V. Veterinary research 94
VI. Breeding—
(1) Cattle-breeding 95
(2) Sheep-breeding 100
(3) Poultry-breeding 101

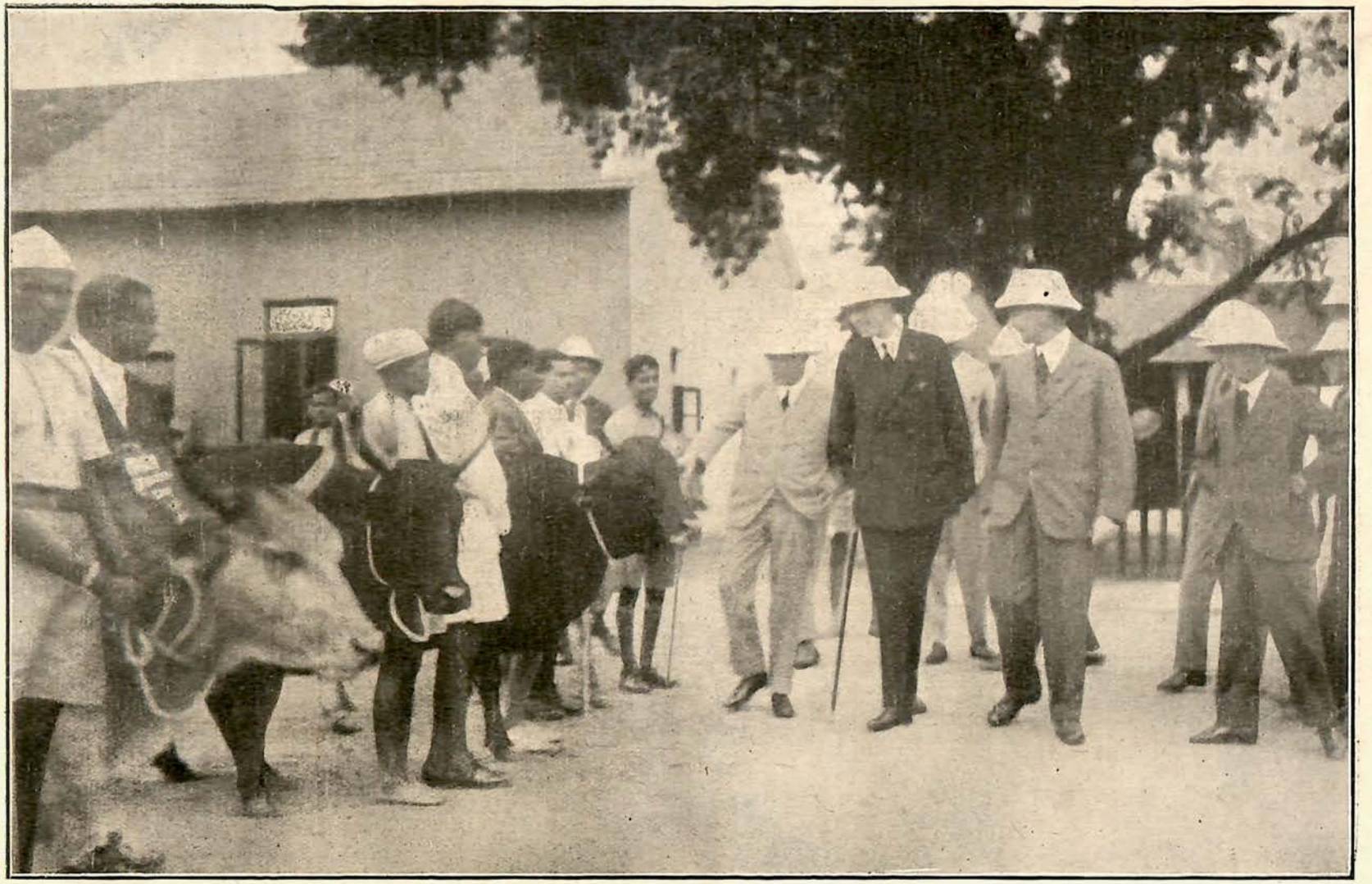
CHAPTER IX. PUBLICATIONS OF THE AGRICULTURAL DEPARTMENTS—

(1) Imperial 102
(2) Provincial 103

CHAPTER X. RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL DEPARTMENTS 105

APPENDIX I. AREAS UNDER NEW AND IMPROVED VARIETIES OF CROPS DURING THE YEAR 1926-27 . . . 111
„ II. LIST OF AGRICULTURAL STATIONS IN BRITISH INDIA IN 1926-27 115
„ III. STAFF OF PROVINCIAL DEPARTMENTS OF AGRICULTURE IN INDIA, 1926-27 124
„ IV. RESULTS OF WELL-BORING DURING 1926-27 . 125

		Page
Appendix	V. Improved implements sold through departmental agency during 1926-27 . . .	126
,,	VI. Improved seed and manures distributed through departmental agency during 1926-27	127
,,	VII. Demonstration and propaganda work during 1926-27	128
,,	VIII. Working of Agricultural Colleges and Schools during 1926-27	129
,,	IX. Operations of Non-credit Agricultural Co-operative Societies in British India during 1926-27	132
,,	X. Working of Provincial Civil Veterinary Departments during 1926-27 . . .	136
,,	XI. Working of Veterinary Colleges and Schools during 1926-27	137
,,	XII. Breeding Cattle issued from Government farms during 1926-27	138
,,	XIII. List of Agricultural Publications in India during 1926-27	139



HIS EXCELLENCY THE VICEROY AT THE IMPERIAL INSTITUTE OF ANIMAL HUSBANDRY AND DAIRYING, BANGALORE. INSPECTING THE HALF-BRED AYRSHIRE-SCINDI CATTLE.

Review of Agricultural Operations in India 1926-27

CHAPTER I.

AGRICULTURAL CONDITIONS OF THE YEAR.

The monsoon of 1926 made a somewhat late start and was weak in the month of June, but in the succeeding two months it showed greater activity than usual. The heavy precipitations recorded in August brought about floods which did considerable damage particularly in the Central Provinces and Orissa. Towards the end of the monsoon the rainfall generally was short except in Burma and parts of Central India where it was excessive. Taking the average for the plains of India, as a whole, the monsoon rain was in excess by 7 per cent., though for Madras (with the exception of Malabar), the Bombay Deccan and Deccan Hyderabad it was below normal. The sowing of *rabi* (spring) crops was prejudiced in Northern India by the lack of moisture in the soil, consequent on the failure of early winter rains, but the season improved in this respect later and outturns were on the whole good. After a respite of some years, swarms of locusts invaded the western part of the country in autumn from Surat to Peshawar and damaged the standing crops. That the loss was less serious than was anticipated may be accredited to effective remedial measures combined with the apparent natural predilection of locusts for wild plant food. Taking India as a whole, the season can be described as having been fairly good ; almost all the important crops gave normal outturns.

The general condition of the agricultural population, depending as it does primarily on good seasons, was satisfactory throughout the year. There was no lack of employment for agricultural labourers.

Though the year saw the abatement of the ravages of rinderpest in some provinces, the mortality from contagious diseases among cattle stood at a high figure. There was no abnormal shortage of fodder.

CHAPTER II.

ECONOMIC WORK ON CROPS.

In the early years of the present century, when the officers of the Agricultural Department took up the task of increasing the productivity of Indian soils and the yields of the staple crops, they found the different varieties of the latter hopelessly mixed. The cultivator up to that time had paid little or no attention to the selection of the seed he used for sowing. There was no source from which guaranteed pure seed could be obtained: India had not yet produced a Garton or a Sutton. The use of mixed seed consisting of different varieties which varied with respect to quality and yield had resulted both in low yields and lack of uniformity in the produce. The consequence was that Indian cereals, oil-seeds and fibres commanded neither confidence nor high prices in the World's markets. Agricultural officers realized that the prime requirement to meet the situation was pure, superior varieties capable of responding to improved soil conditions and suitable both for home consumption and export. Though the percentage of the total cropped area sown with improved varieties is still small, the fact remains that it is already considerable and is increasing every year. That good progress is being made in this direction will be apparent from the following figures :—

Improved crop	Area in acres in 1923-24	Area in acres in 1926-27
Cotton	2,348,882	3,586,768
Wheat	1,398,885	2,893,865
Rice	603,603	882,547
Jute	210,262	505,059
Sugarcane	50,604	207,989
Other crops	467,146	739,327
	5,079,382	8,815,555

The area under improved crops has increased by 73 per cent. within the last three years. The increase has been at the rate of approximately 1¼ million acres a year. The cost to Government of evolving improved strains and varieties of seed has been small: the cost to the cultivator of substituting them for the less profitable kinds he used to grow has been well within his means, for the premium charged for the improved article has been insignificant.

The introduction of improved varieties has, in the case of some crops such as cane, increased the net profits of the cultivator by 50 to 100 per cent. To this fact the planters of Bihar and other witnesses testified in their evidence before the Royal Commission on Agriculture regarding the yields obtained from the Coimbatore canes which they are now growing. These canes are now grown on an area of 44,000 acres in the Western Circle of the United Provinces: the total area in Northern India is reckoned to be in the neighbourhood of a lakh of acres. The improved varieties of jute selected in Bengal now occupy an area of over half a million acres. Their yields in fibre exceed those of the local races which they are replacing by about 25 per cent. In Berar, early maturing varieties of ground-nut introduced by the department give, at current prices, a gross profit which is approximately three times as much as that obtained from cotton and twice as much as that obtained by cultivating *juar* (*Sorghum vulgare*). In Khandesh and Upper Gujarat where the cultivation of short-stapled cotton was during the year under review less remunerative owing to the fall in prices, an improved variety of ground-nut has saved the situation and doubled the income of cultivators. The substitution of this valuable oilseed for inferior millets has, in other parts of India, raised the value of the return per acre from about Rs. 15 to Rs. 60 per acre. In the Central Provinces the spread of Roseum cotton, a heavy yielding variety selected by the Department of Agriculture many years ago, is reported to have added crores of rupees to the farming profits of cotton-growers in that province. While for the period 1915 to 1918 India produced on an average 1,161,000 bales of medium staple cotton, the figure for 1925-26 was 2,145,000 bales the greater part of which has been used in Indian cotton mills for the production of finer warp yarns to the advantage of her textile industry. The introduction of these improved cottons has made great headway

more especially in the Punjab, Bombay and Madras. A wilt-resistant variety of gram introduced into Burma has made it possible to grow this crop in disease-infested fields which had come to be known as " the graveyard of gram ". These are but a few of the instances in which departments of agriculture have, by increasing the value of the crops grown, added substantially to India's material welfare.

The figures showing the area under improved varieties for 1926-27 do not by any means do full justice to the work of crop improvement which has been done by the departments, as the selected varieties of certain crops are now so generally grown in the provinces that the departmental statistics are no longer a true representation of the extent to which they have spread. Assuming that the addition of profit obtained from the introduction of departmental varieties is on an average Rs. 12 per acre—and it is almost certainly higher than that—it is estimated that the annual value of all the crops under improvement has been enhanced by over Rs. 10½ crores. Further, the varietal work on crops has prepared the way for improvements in cultivation and manuring. It has given the ryot an incentive to better methods of treating his land by showing him that there are varieties of crops which respond to more intensive methods of cultivation.

I. Rice.

Rice is the premier crop of India both as regards area and the value of its outturn. On an average 35 per cent. of the total cultivated area is under rice; in Assam the percentage is nearly 80, in Burma 74, and in Bengal 70. Being mainly a monsoon crop, both its area and yield are affected, to a larger extent than in the case of any other staple crop, by the amount and distribution of the rainfall. Owing to the unfavourable weather conditions which existed in some of the principal rice tracts at the time of sowing, the total area sown (79,233,000 acres) and the crop harvested (29,636,000 tons) showed a shrinkage of 3·8 per cent. as compared with the previous year. The area and outturn were less than the averages of the previous quinquennium by 2 and 4·6 per cent. respectively.

As India required for her own consumption 93 per cent. of the rice produced, the reduction in outturn was reflected in the export

trade which was valued at only Rs. 33,20 lakhs as against Rs. 39,97 lakhs in the previous year. Over 87 per cent. of these exports were from Burma; the other provinces cultivate rice mainly for home consumption. Outside Burma, the main object which the Agricultural Departments have in view in their work on rice is an increase in the yield: improvement in quality to meet the export demand is of very secondary importance.

With nearly 20 million acres, or 25 per cent. of the total acreage under the crop, BENGAL is the most important rice-growing province in India. The efforts of the plant-breeders of this province have therefore been largely directed towards the improvement of this crop. In Indrasail and Dudshar the department has two transplanted *amans* (winter rices) which are suited for the heavy and light soils found in Northern and Eastern Bengal respectively. The selected variety in the *aus* (autumn rice) group is Kataktara which yields heavy crops on fertile land. During the year under report these are estimated to have been sown on an area of 139,000 acres. Owing to the widely varying conditions of soil and climate these types are not suitable for all parts of the province. For Western Bengal, in particular, types are required which, while not deficient in yielding powers, will mature earlier. The possibility of evolving such types is receiving attention. The problem involved is being tackled both by selection and by hybridization, and some of the *aus* and *aman* crosses obtained are promising. Selection work on the fine Balam rice, which seems to thrive well particularly round the coast line of the Bay of Bengal, has yielded three strains which are about 12 per cent. better than the ordinary local seed These are being multiplied for large-scale field trials. It has been confirmed that *aus* and *aman* paddy harvested, respectively, 19 and 25 days after flowering give seed of good germinating capacity.

In addition to the main paddy breeding station at Coimbatore, there are three sub-stations in the principal rice-growing tracts of the MADRAS PRESIDENCY. The four types distributed from Coimbatore (G. E. B. 24 and CO. 1, 2 and 3) and seven from Aduturai (A. 1—7) have achieved popularity: they were grown during the year over an area of 145,787 acres. From Coimbatore four more strains will be available next year for distribution: two are heavy

yielders and two are likely to be appreciated on account of their quality and uniformity. The selections from Aduturai have created such a good impression in the Tanjore delta that the demand for seed was many times more than the amount which the station could supply. The other sub-stations at Maruteru on the East Coast and at Pattambi on the West Coast being comparatively new, the breeding work there has not got beyond the initial stage. Good progress has been made at Coimbatore in investigating the possibility of combining desirable characters such as disease resistance, good stand, well filled grains, etc., in a single variety by hybridization. This work is of particular importance in the Tanjore delta where in some years not a single plant is found free from *Piricularia oryzæ*. The phenomenon of sterility has shown at Coimbatore an appreciable degree of linkage with the close bunching arrangement of grains in the panicle, which arrangement is in turn recessive to the loose, or sparse, type of earhead. Awning continues to evade a numerical ratio. The practice of transplanting paddy seedlings, either singly or in twos and threes, instead of in bunches, has now spread over lakhs of acres. In the neighbourhood of Samalkota alone, about 155,500 acres were thus planted last year.

The pure strains of Hoito, Bommadewa, Shwe-at, Taungdeikpan and Ngasein paddies isolated by the BURMA department were grown on 287,939 acres, as against only 100,000 acres four years ago. They are appreciated by the growers mainly on account of their high yield, the increase given over unselected varieties being 200 to 500 lb. per acre. They are popular, too, with the millers who prefer white, bold, uniform grain which will not break in milling. They willingly pay premiums varying from Rs. 5 to Rs. 10 per unit of 100 baskets (4,600 lb.) for such paddy. While active steps are being taken to make available larger quantities of seed of the types in demand, the search for strains which will fit into the special conditions of different tracts still continues at Mandalay, Hmawbi and Akyab, and exotics, hybrids and pure line selections from indigenous types are under observation. A manure commercially known as Ammophos, which is prepared synthetically from atmospheric nitrogen and mineral phosphates, has given at Hmawbi and Mandalay a net profit of Rs. 12 and Rs. 8 per acre, respectively.

Seed-rate experiments at Mandalay have repeatedly proved that 5 baskets (230 lb.) per acre of nursery gives as good results as 10 or 15 baskets.

In BIHAR AND ORISSA, Dahia paddy maintained its superiority despite the fact that the season was abnormal. The co-operative banks having taken up the distribution of seed, the area under this variety is steadily increasing. The three selections made from Kakharua at Cuttack have become popular in parts of Orissa. Latisail, a variety with short, strong straw, imported from Assam, has done so well that an attempt is being made at Sabour to hybridize it with Dahia—an early variety with short, weak straw—in the hope of obtaining a mass of material from which types suitable to a great range of conditions may be selected. Ammophos, containing approximately 20 per cent. each of ammonia and phosphoric acid, has in this province, too, proved an extraordinarily effective manure for paddy both on the farms of the department and in cultivators' fields. In experiments made on a large number of plots to which it was applied at the rate of 80 lb. per acre (costing about Rs. 10) it increased the acreage yield by 490—900 lb. of paddy and 14 to 19 cwt. of straw. Arrangements have been made to demonstrate the value of this manure in the fields of 350 selected cultivators.

The rices recommended in Assam for their high-yielding capacity are the *sail* varieties Georgesail, Latisail and Indrasail; the *aus* Murali 36-30 and Basmati and the *asra* Birpak. Manuring with bone-meal has been found to give an immediate economic return; the residual effect of this manure lasts up to the fourth year.

From a collection of 1,300 rices made at Cawnpore in the UNITED PROVINCES, 183 pure types with distinctive characters have been isolated. The best of these were multiplied during the year on a field scale, and over one ton of seed was given out to selected growers for trial under local conditions.

For the Eastern and Southern Circles of the CENTRAL PROVINCES, selected strains of Luchai, Bhondu and Bhata Gurmatia, which are late, medium and early rices, respectively, maintain their popularity: they yield on an average about 450 lb. more per acre than the local mixtures. Two new dark-skinned types, Karia-

gurmatia and Surmatia, isolated on the Labhandi farm promise to be of value to cultivators in the Chhattisgarh Division who practise the broadcast system of sowing rice, as their coloured stems distinguish them from the wild self-sown rices found as weeds in the paddy fields of this Division. The early types Nos. 6 and 13 selected on the Adhartal farm are doing well in parts of the Northern Circle where in the absence of the irrigation facilities very early varieties are in demand. Selection work on late paddies has given two strains which are better yielders than the old favourite Dilbuxa. Drilling of rice seed at the rate of 45 lb. per acre promises to solve the labour difficulty involved when transplantation is resorted to !

Rice-breeding work at Karjat in the BOMBAY PRESIDENCY has yielded two types of Kolamba rice, *viz.*, No. 42 and No. 79, which are suitable for the North and South Konkan respectively. They give an increased outturn of 20—35 per cent. over the local mixtures, and are now grown over nearly two lakhs of acres. Selection work at Ratnagiri and Mugad is not so advanced, but strains of some promise have been evolved which are now being tested in the villages. The rice crop of Sind is being dealt with at Larkana where types of Kangni, Prong and Jajai are now available for distribution. In the North Konkan, a dressing of sulphate of ammonia has proved a good substitute on rice seed-beds for the *rab* method of burning the land. When applied to the crop at a later stage, quantities up to 300 lb. per acre have proved profitable. On the laterite soils of the South Konkan and Kanara, bone-meal is more economical than ammonium sulphate.

Preliminary trials with the Karjat selections of Kolamba rice have proved them to be desirable substitutes for the coarse rice Kada commonly grown in the Navasari District of the BARODA STATE.

Early maturing varieties of paddy such as Banku, Chintamani Sanna and Coimbatore selections are being distributed in the MYSORE STATE in which they have shown great adaptability to malnad conditions.

In the TRAVANCORE STATE, the use of departmental seed com bined with economic planting and manuring has resulted in an increased profit of Rs. 24 per acre.

II. Wheat.

What rice is to Eastern and South India, wheat is to Northern India. The acreage is second only to that of rice, and is on an average 10 per cent. of the cultivated land of all India. The area of 31,272,000 acres sown during the year was higher than that of the preceding year by 2 per cent., while the total outturn of 8,941,000 tons represented an increase of 3 per cent. over that of the previous year. Almost the whole of this produce remained in the country for local consumption; only 234,900 tons of wheat and wheat flour valued at Rs. 4,03 lakhs were exported.

The isolation of heavy yielding wheats of high grain quality and their introduction into general cultivation will always be reckoned as one of the greatest achievements of the Imperial Department of Agriculture in India. Pusa 12 has proved to be the most successful of all the early Pusa selections on account of its great adaptability and high yielding power. Yields as high as 27 cwt. to the acre have been obtained, and this wheat is now cultivated on a large scale in parts of the United Provinces, the Simla Hill States, the Eastern Punjab, Sind and some of the Rajputana States. Pusa 4, besides possessing a large translucent grain of very fine appearance, matures very rapidly. It has proved particularly suitable for parts of Bihar, Bundelkhand, the North-West Frontier Province and Gujarat. The reputation of these types is by no means confined to India. Pusa 12 is doing well in the Argentine, while Pusa 4 is well established in Australia and is being regularly distributed by the Queensland Agricultural Department. Good reports of the latter have been received, too, from Rhodesia. Pusa 100 has found congenial conditions in the eastern and southern districts of the Central Provinces.

In more recent years, three new types have been fixed by hybridization which, while being as heavy yielders as the older selections, have certain special characters well suited to particular localities. Pusa 80—5 obtained by crossing Pusa 6 with Pusa 4 has done very well in certain parts of Bihar. During the year under report, it headed all varieties grown at Pusa with the excellent yield of 2,500 lb. per acre. The two other types called Pusa 52 and Pusa 54 (Pusa 6 × Punjab 9), being awned wheats, are welcomed in tracts where the beardless Pusa 4 and Pusa 12 suffer from

the depredations of birds. Crosses between some of the improved Pusa wheats and the famous Australian wheat Federation have lately been made and favourable results are anticipated.

The PUNJAB is India's premier wheat-growing province: over 34 per cent. of the total acreage under wheat in India is to be found in this province. Of the 10,626,000 acres sown during the year, 1,440,289 acres or over 13 per cent. were under improved varieties. The departmental seed distribution is of Punjab 8 A, which is steadily replacing Punjab 11; the former gives a higher yield of both grain and straw both on irrigated and rain-fed lands and fetches a premium in the market. The older selection is, however, still grown on some five lakhs of acres. The other improved varieties under cultivation are Pusa 4, Pusa 12 and Punjab 17. The first has been found especially suitable for low-lying riverain lands; the second is popular in tracts where wheat is irrigated from wells, while the last named is in demand in parts of the Multan Circle. The results of the experiment designed to determine the effect of varying the number of irrigations indicate that whilst on a light soil the percentage of mottled grains may rise or fall with an increase or decrease in the number of irrigations, on a heavy soil what little mottling occurs is independent of such influence, provided lodging does not occur.

With an area of 6,831,000 acres, which is 23 per cent. of India's total wheat acreage, the UNITED PROVINCES is the second largest wheat-growing tract in India. About 14 per cent. of the area sown with wheat in this province is reckoned to be under improved varieties—mainly Pusa 4 and Pusa 12. Pusa 52, Pusa 54 and Cawnpore 13 are distributed in localities where a bearded wheat is in demand. The number of seed depôts from which the cultivators can purchase pure seed of improved varieties has been increased to 148. The profit of Rs. 39,000 earned by these depôts on the sale of 32,900 cwt. wheat seed indicates that the growers are willing to pay for seed of the improved varieties.

Of the large number of the world's more noted varieties of wheat tested since 1910 at Tarnab in the NORTH-WEST FRONTIER PROVINCE, none has yet surpassed Pusa 4 in all-round merit. Australian Federation, a later variety, gives a larger outturn when grown on land which has lain fallow during the *kharif* season; but in the

Peshawar Valley wheat generally follows maize, chillies or other monsoon crops, and under such conditions Pusa 4 stands supreme. Among the wheats tested this year, Pusa 80—5 did well. The area under Pusa 4 is reckoned to be about 300,000 acres or 30 per cent. of the total area under wheat in this province.

Pusa 52 has proved superior to other wheats in South BIHAR where it has proved to be more rust-resistant than the local varieties and when grown without irrigation a heavier yielder than Pusa 12. At Sepaya in North Bihar, Pusa 12 and Pusa 80—5 have done very well. In North and South Bihar, the demand which has arisen for the seed of Pusa wheats is being met to some extent by co-operative banks.

In the CENTRAL PROVINCES, Pusa 100 continues to make headway in the irrigated tracts of the eastern and southern districts. At Labhandi, Pusa 52 has been found particularly suitable for fertile land ; it did well, too, on the Tharsa farm. The new hybrids A. 113 and A. 115 are doing well in the Northern Circle ; they will in course of time probably replace AO 13, AO 85 and AO 88. A. 115 having acquired the trade name of Sharbati, secures a premium of As. 12 to Re. 1 per maund over the best Pissi. The total area under these high-yielding strains is estimated to be 135,148 acres. The breeding work in progress at Nagpur aims at producing a strain combining the earliness of the local Hawra with the high yielding capacity of some Punjab wheats which will suit the Nagpur-Wardha tract. An early bearded wheat required for the plateau districts is also receiving attention.

Pusa 12 has established its reputation among the cultivators of North SIND who have adopted it as their standard wheat. The strains of local wheat (Phundnani C. P. H. 27 and Thori A. T. 38) isolated by the Provincial Department for high yield are also spreading. Although Wajia still forms the bulk of the wheat cultivation in the BARODA STATE, the rust-free Pusa varieties are very popular in some localities.

III. Cotton.

During the year under review the area under cotton fell to 24,976,000 acres as compared with 28,491,000 acres in 1925-26, the estimated yield as given in the Supplementary Cotton Memo-

randum being 4,973,000 bales—a decrease of 1,277,000 bales as compared with the previous year. The average yield per acre was 80 lb. of ginned cotton, as compared with 88 lb. and 86 lb. per acre, respectively, in the two preceding years. It should be noted, however, that the weekly returns of cotton pressed, as now received from all provinces in British India and from a number of Indian States, indicate that the total production of cotton had been considerably under-estimated in several provinces. A complete check is not possible as all Indian States do not yet furnish returns of cotton pressed, and complete information with respect to the movement of cotton from one province to another or from Indian States to British India is not available. There is reason, however, to believe that the cotton crop in British India was under-estimated by not less than $1\frac{1}{2}$ lakhs of bales. The largest discrepancy was in Berar where 746,714 bales were pressed as against 516,940 bales forecasted.

The quantity of raw cotton exported during the year ending March 31st, 1927, was 3,188,000 bales of 400 lb., as compared with 4,173,400 bales in the previous year and an average of 3,103,200 bales for the preceding quinquennium. The value of cotton goods exported was Rs. 10,75 lakhs.

The final estimate of the American crop of 1926 was 17,977,000 bales of 500 lb.; the final estimate of the area planted was 48,730,000 acres, as against the first estimate of 48,898,000 acres. This crop established a new record both for area and yield. For 1927 the first estimate of the area under cotton was 42,683,000 acres, as compared with 48,898,000 acres at the same time in the previous year: the crop is estimated to produce about 13 million bales of 500 lb. Consequent on the fall in price of American cotton the Bombay price of Broach cotton fell from Rs. 351-8-0 per candy on April 1st, 1926, to Rs. 293 on March 5th, 1927. The lowest point was reached on the 13th of December when the Broach futures contracts was quoted at Rs. 238-8-0 and December—January Oomras at Rs. 227. From the lowest point there was a steady recovery. Liverpool prices for Middling American on the corresponding dates were 10·16, 7·71 and 6·48*d.* per lb., and it will be observed that Indian prices did not follow American prices but remained considerably above Liverpool parity. Further, the margin

between Broach and Oomras narrowed very considerably and exports were limited to short-stapled styles. Owing to the partial failure of the Punjab cotton crop and low yields in certain other staple cotton areas there was an actual shortage in India of staple cotton, and this fact doubtless was mainly responsible for the very considerable imports of American cotton into India which took place during the year, though a contributory cause was certainly the low price of American cotton—especially of low grade American cottons which are not tenderable in Liverpool. For the twelve months ending March 31st, 1927, such imports amounted to 139,000 running bales; for the twelve months ending August 31st, 1927—the end of the Indian cotton year—they amounted to 325,000 bales. The exact effect of these large imports of American cotton on the prices received for Indian staple cottons is somewhat difficult to estimate. Normally, the parity between Bombay and New York and Liverpool prices is an exporting parity and, since it costs approximately half an anna per pound to move cotton in either direction, it is clear that the importing parity must stand at a considerably higher figure. Whilst it is undoubtedly true that but for the large supplies of cheap low-grade American cotton the prices of Indian staple cottons would have been higher, it is obvious that the Indian mill demand for indigenous cottons had an important effect on the prices realized by growers. For example, the selected Surat cotton, known as Surat "Farm" or Surat 1027, continued to command the same premium over Broach as in the previous season, *viz.*, Rs. 70 per candy, despite the large difference in basic prices. Hence there is little reason to fear that cultivators of the *best* staple cottons did not receive a fair price for their produce having regard to the course of world's prices generally; the position of producers of lower quality cottons, which only just come into the staple cotton class, naturally was not so satisfactory. The lower prices of 1927 had some effect on the cotton area sown in the current year, the area recorded in the third forecast being 23,178,000 acres, as compared with 24 million acres at the same time in 1926.

THE INDIAN CENTRAL COTTON COMMITTEE has now completed its sixth year since its constitution as an advisory body and its fourth year since its incorporation under the Indian Cotton Cess

Act, 1923. The Committee's main work has been the improvement of cotton marketing, prevention of malpractices and the promotion of research for the improvement of cotton growing.

Cotton Transport Act. The Committee has continued to devote attention to the working of this Act in the various provinces and Indian States. In the Bombay Presidency the only important alteration has been the removal of the restrictions on the transport of cotton *by road* between the three zones in Surat which was made effective by notification dated the 10th of August, 1926; the first crop to be affected was that harvested in March 1927. This change was made in accordance with the policy adopted by the Government of Bombay of establishing one improved variety of cotton throughout the whole of that portion of Gujarat lying south of the river Narbada and including some 175,000 acres of cotton annually in the Bombay Presidency and 159,000 and 150,000 acres in the Baroda and Rajpipla States respectively. Since the Cotton Transport Act was introduced in 1923, great progress has been made in establishing the variety known as Surat 1027 in the region north of the river Tapti. In the Ankleshwar Taluka of the Broach District, the most northerly part of this zone, the extent to which this variety is now grown justified the introduction of new standards for Ankleshwar cotton by the East India Cotton Association and to similar action being taken in regard to the cotton of the Rajpipla State which is now recognized as equal to the very best Surat. The concession referred to above was made conditional on the growing of inferior cotton in the zones affected being discontinued, and a proviso to this effect was included in the notification. As certain Co-operative Cotton Sale Societies in the neighbourhood of Sonsek have continued to distribute an inferior and impure variety of seed, it is extremely probable that the original restrictions will have to be reimposed, as required by the notification passed by the Legislative Council, until such time as the organized growing of inferior cotton in the North Surat zone is discontinued.

In the Southern Division of the Bombay Presidency three protected areas have again been maintained, *viz.*, the Bagalkot area, the Bijapur area and the Kumpta-Dharwar area.

Complaints were received of the mixing of superior and inferior qualities of Kumpta cotton and of Dharwar-American (Upland)

with Kumpta. This short-sighted practice cannot be dealt with under the Cotton Transport Act as separate protected areas for Kumpta and Dharwar-American cottons have not yet been found practicable, and other methods of dealing with such abuses are under consideration. In the meantime the Agricultural Department has developed and extended its organization for the supply of pure seed of the two improved strains.

In the Madras Presidency the areas at present notified have not given satisfaction. Proposals for modifying the present boundaries are at present under the consideration of the Madras Government.

In the Baroda State the Gaekwar's Government have continued to enforce a Cotton Transport Law similar to the Cotton Transport Act and have maintained three protected areas corresponding with the Bombay zones with which they are interlaced. Their co-operation in this respect has helped materially the improvement of Gujarat cottons.

In the Rajpipla State a more comprehensive law, the Cotton Improvement Act, has been in force since 1923 which, in addition to prohibiting the importation of cotton from outside the State save on a special permit, declared the whole State as a one-variety area and prohibited the growing of inferior cottons. The same law includes provisions similar to those of the Cotton Ginning and Pressing Factories Act. This is the first example of legislation for the establishment of "community cotton growing" in India and has been remarkably successful; reference has been made above to the enhanced reputation which Rajpipla cotton has earned.

Another Gujarat State, Chota Udaipur, has recently passed a similar Act and is concentrating on the production of a single variety, *viz.*, Surat 1027.

The Nizam's Government has recently passed the Hyderabad Cotton Transport Ordinance which is on the lines of the Cotton Transport Act. A protected area has been notified which includes the most important portion of the tract growing the well-known Hyderabad Gaorani cotton, now in great demand by Indian mills, but threatened with extinction owing to mixing with short-stapled cottons from other areas.

The Holkar State, on the receipt of a representation that the importation of Rajputana Bengals cottons for mixing purposes was spoiling the quality and reputation of Central India cotton, introduced a Cotton Transport Act which will come before their Legislative Committee shortly.

Cotton Ginning and Pressing Factories Act. The Central Cotton Committee has devoted great attention during the year to the working of this Act. A gratifying feature is the extent to which similar legislation has been introduced by Indian States; the marking of bales and weekly returns of cotton pressed will shortly be practically universal throughout India. The rules framed under the Act have proved satisfactory and the method of marking bales prescribed has not presented any serious difficulty in practical working. The series of reports received by the Committee from various sources indicate that the marking of bales is now proceeding satisfactorily in most pressing factories. Minor breaches of the rules due to misunderstanding have been brought to notice and corrected. A certain number of instances of failure to observe the provisions of the Act again came to the notice of the local authorities who have instituted prosecutions in a few cases. Reference may be made to an important arbitration award under the bye-laws of the East India Cotton Association where bales of cotton which were not marked in accordance with the Act were declared " not a fair tender "—a decision which has brought to very prominent notice the protection afforded by Section 14 of the Act.

The Committee is at present engaged on the examination of further measures required to deal with such abuses as the watering of cotton in pressing factories and the mixing of cotton of different growths, and is examining in particular whether additional legislation is necessary or whether organized action by cotton trade associations is capable of dealing with the problem.

The Committee's enquiry into the finance of the cotton crop up-country was referred to in the last report. Results of three investigations have now been examined in detail and five others are in progress. The detailed reports and pamphlets explaining the major conclusions reached have been published; it will suffice to say here that, in the areas investigated, the grower's greatest need was better facilities for marketing his cotton.

Primary cotton markets. A distinct step forward in this direction has been made by the passing of the Bombay Cotton Markets Bill by the Bombay Legislative Council since the close of the year under report. In this Bill, which will shortly become law, definite provision has been made for representatives of cotton growers on market committees which will control the cotton markets to be notified under the Act. A regulated cotton market governed by a market committee including growers' representatives has been established at Sanawad in the Holkar State: the success of this market has led to steps being taken for the constitution of four more in the near future.

In the Central Provinces and Berar, where organized cotton markets have existed for many years, the amending of the market rules and bye-laws in order to remedy defects which a recent enquiry has disclosed, are under the consideration of the Local Government.

Marketing of improved cottons. The Committee has continued to supply the East India, Liverpool and Manchester Cotton Associations with type bales of those improved varieties of cotton which the Agricultural Departments have established on a commercial scale. As explained in last year's report, the object of these type bales is to enable merchants and spinners alike to obtain reliable samples, described under the Agricultural Department's varietal names, for comparison with commercial types of Indian cotton offered by various shippers. For reasons explained at the commencement of this chapter, the export of improved Indian cottons has not been a commercial possibility during the year under report, but in normal years India has an exportable margin of such stapled cottons, and it is clearly to the advantage of the cotton-grower that such cottons should be known in the world's major markets.

Measures to prevent the introduction of the Mexican boll-weevil. Reference has been made to the large quantities of American cotton imported into India during the year under report. All this cotton had been satisfactorily fumigated with hydrocyanic gas at the port of Bombay. Though imports were three times as large as in any similar period in the past, the cotton was all fumigated without any serious hitch and with comparatively little delay. To this satisfactory state of affairs the hearty co-operation of the Bombay

Port Trust has largely contributed. The technical details of fumigation were controlled by the staff of the Committee, the actual supervision being done by qualified chemical assistants provided by the Government of India.

Cotton statistics. The Committee has continued its efforts to secure an improvement in Indian cotton statistics. It has issued monthly reports on the consumption of Indian cotton in Indian mills, which are based on the statutory returns under the Cotton Cess Act, and issued a weekly statement of imports and expected arrivals of American cotton. The Government of India have sanctioned the compilation and publication of monthly returns of cotton exports by rail from each internal trade block, and proposals for further improving the rail-borne statistics of cotton are under consideration. The Government of India has approved of a proposal made by the Committee for an improvement in the fifth (supplementary) all-India cotton memorandum.

Cotton research. The Committee was able to record very definite progress on its various research schemes. The Technological Laboratory has had a busy year and the facilities which it offers have been very fully utilized by agricultural research officers in the various provinces, as will be obvious from the fact that during the twelve months ending August 31st, 1927, no less than 79 samples have been tested for Agricultural Departments in addition to 21 standard cottons which are dealt with in very considerable detail every year. An outstanding feature of the year's work is the progress which has been made on the study of the fibre characters of Indian cottons. Methods have now been worked out for determining on each of the cottons undergoing spinning trial, the fibre-length distribution, ribbon width, convolutions, rigidity, hair strength and fibre-weight per centimetre. The work of the Spinning Laboratory has enabled several bulletins to be published on matters of practical importance such as the effect of varying humidity on spinning, the effect of various degrees of cleaning treatment on low-grade Indian cottons, whilst the annual bulletin "Technological Reports on Standard Indian Cottons" now contains a good deal of important information not obtainable elsewhere. As has been stated on previous occasions, the work of the Technological Laboratory is of great importance to cotton botanists

as it affords a means of testing the commercial value of new strains.

Work at the Indore Institute of Plant Industry has been steadily developed and progress has been made with general investigations into the botany, physiology and cytology of Indian cottons and of the special problems connected with cotton-growing on the black soils of Central India. The work of the Institute has aroused much local interest: two more Indian States, *viz.*, Tonk (Rajputana) and Beawar (Central India) now contribute to the funds of the Institute which is financed partly by the Central Cotton Committee and partly from contributions from ten Indian States. Seven research students appointed by the Indian Central Cotton Committee were working at the Institute during the year.

Steady progress has also been made on the research schemes financed by the Committee in various provinces. Work on the new Sind Research Scheme at Sakrand commenced in April 1927. At that station the Committee provides for physiological research on cotton with special reference to the water requirements of the cotton plant under new canal colony conditions in Sind.

The Committee now finances thirteen provincial research schemes of which five deal with cotton breeding, three with cotton physiology, two with cotton diseases and three with cotton entomology.

The Madras " herbaceum " cotton-breeding scheme is now in its fifth year and deals with the improvement of the Uppam type of cotton. A number of pure stains have been isolated and are now undergoing yield and spinning trials: several of them show considerable promise.

The Central Provinces and Berar botanical research scheme has as its object the production of more profitable cottons with a better staple and higher resistance to the cotton-wilt disease than the existing types; it also includes work on the factors limiting the yield of cotton in that province. The work has included the survey and detailed study of a wide range of types and this promises to throw light on a number of important points in the botany of Indian cottons. An improved type, known for the present as Verum No. 262, has given good results on an experimental scale and has been shown by spinning tests to be suitable for the production of 20s warp counts as compared to the 10s—12s counts for which the

local cottons can be used. This selection has now been grown on a scale of 700 acres and special arrangements for marketing the produce have been made in consultation with the Committee. An important characteristic of this cotton is its high agricultural yield and wilt-resistance.

In the Punjab botanical research scheme attention has been devoted to the improvement of the Punjab cottons from the varietal standpoint and to the physiology of the cotton plant under canal colony conditions. The Punjab is already in possession of three important types of Punjab-American cotton, *viz.*, 4 F., 285 F. and 289 F., and, concurrently with further plant breeding work, arrangements have been made for the maintenance of the purity of the seed supply of the existing types. Considerable attention has been devoted to the cause of the low yield of American cotton in 1926-27 in the Punjab Canal Colonies, and in this connection some extremely interesting results have been obtained on the non-dehiscence of the anthers of the cotton plant at certain periods. Preliminary results indicate that the high soil temperatures in the early part of the season may be largely responsible for the unsatisfactory growth of the cotton plant, though it is probable that the partial failures which occurred in such years as 1920-21 and 1926-27 were due to a combination of unfavourable factors. There is reason to believe that better conditions for healthy plant development can be obtained by modifying cultivation and irrigation operations during the months of June and July.

The American cotton-breeding scheme at Dharwar in the Bombay Presidency deals with the improvement of the Dharwar-Upland type and more especially with the study of a hybrid between the Upland strain (Gadag No. 1) and Sea Island. The work has now reached the fifth generation, and there are grounds for believing that a cotton with a much better lint than Gadag No. 1 and with an agricultural habit suitable for the tract has been obtained.

In the Khandesh cotton-breeding scheme the Committee has supplemented work which had already been carried on by the Bombay Agricultural Department for some years, and has provided funds for additional staff to deal adequately with the purification and testing of several improved cottons which have been isolated from what is believed to be a Bani-Comilla cross. Several of these

new strains have shown themselves suitable for the production of 20s warp counts, and one of these, known as Dhulia No. 1, has been grown on a scale of about 700 acres during the present year.

Reference has already been made to the work on cotton physiology in progress at Lyallpur and Sakrand. The Surat physiological research scheme is the oldest of these schemes, and deals particularly with the question of bud, flower and boll shedding and the consequent reduction of yield. As the problem is closely connected with the damage caused by the *Earias* boll-worm, it is convenient to discuss the results obtained on this and on the Surat entomological research scheme together. The effect of the *Earias* boll-worm attack in Gujarat is to change entirely the character of the fruiting of the cotton plant; the form of the plant is greatly altered by the pruning which results from the early attack on the shoots and many of the early flower-buds drop. Plants artificially protected from boll-worm damage show normal development and are some weeks earlier in fruiting. With the long growing season characteristic of the Surat District, the early loss of potential bolls is to a considerable extent made up for by continued fruiting at the end of the season so that, especially in favourable seasons with good cultivation, the actual loss of crop is not so great as was supposed. Only a portion of the bud and boll shedding is due to *Earias*, and work in the earlier years of the scheme showed that the greater part of the loss is not due to pathological factors. The work of the last two years has shown that the available water-supply in the lower part of the root-range of the plant and the available plant food supply, especially nitrogen, at that depth have an important bearing on the problem. This conclusion is being followed up and field experiments are now in progress to test various ameliorating measures, the object being to extend the successful fruiting period of the plant. Work on the entomological side has indicated one possible method of boll-worm control, *viz.*, by the maintenance of a soil mulch to prevent the successful pupation of the earlier generations of the insect.

The pink boll-worm (*Platyedra gossypiella*) research scheme at Cawnpore has yielded very definite results. Two years' further work is required to clear up certain details, but it has been practi-

cally established that if all the cotton-seed of a sufficiently large tract can be treated by heat, the pest can be controlled. It has been definitely shown for several years that when cotton plants are protected from pink boll-worm attack, a very marked increase both in yield and quality results, and even at a most modest estimate, control of this pest would add at least 25 per cent. to the value of the United Provinces cotton crop. The small-scale experiments have been repeated and confirmed on a field scale on 400 acres of cotton grown under ordinary cultivators' conditions, but in an isolated block within which *all* cotton-seed was treated by heat before the sowing season. Further important information has been obtained on the flight range of the moths and on possible alternative methods of re-infection. The logical development of these results is that all ginning factories in future should be equipped with heat machines for the treatment of all cotton-seed (whether intended for sowing or not). When both yield and quality are taken into account, the benefit to the grower from control measures should be at least Rs. 30 per acre, whereas the cost of treating the cotton-seed produced from an acre is not likely to exceed 3 annas. The Central Cotton Committee has given a further grant for the purchase of experimental heat treatment machines and an enhanced recurring grant for a period of two years to enable the commercial aspect of the treatment of seed in ginning factories to be fully investigated.

The Punjab entomological research scheme is of recent origin and provides for the development of the investigations carried out by one of the Committee's research students into the incidence of the pink boll-worm in the Punjab. The pink boll-worm is at present definitely a serious pest in the south-east of the province, less important elsewhere and *relatively* un-important in the canal colonies. The object of the scheme is to ascertain what limitations, climatic or otherwise, actually exist to the spread of this pest.

The Committee finances two research schemes on the cotton wilt disease, one at Dharwar in the Bombay Presidency and one at Nagpur in the Central Provinces. Though it cannot be said that the problem has been solved, a good deal of important information has been collected which will be published shortly in a Memoir on the subject of cotton wilt.

Work in the Provinces. As stated in last year's report, cotton-breeding work is being conducted at five experimental stations in the BOMBAY PRESIDENCY, *viz.*, four in the Presidency proper and one in Sind, each station being situated in a distinct cotton tract. Reference has already been made to the success achieved with the Surat 1027 type which has been adopted as the standard for the whole of the area south of the Narbada, both in British territory and in the adjoining Indian States, particularly Baroda and Rajpipla. The Director of Agriculture reports that a new hybrid known as Surat No. 5 shows considerable promise as it combines with good staple a higher ginning percentage than Surat 1027. It should be stated, however, that spinning tests indicate that this cotton is not equal to Surat 1027 in spinning value, and that very considerable caution is therefore called for before this, or any other new type, is given out in place of the existing improved strain which has been such a marked success, especially as Surat 1027 finds a special market amongst Indian mills for the production of the finer warp yarns.

The hybrid cotton known as Broach 1 A. 9, intended for the Broach area north of the Narbada, where it will replace a high ginning cotton of shorter and much more variable staple than Surat, has continued to show promise. The tests carried out at the Central Cotton Committee's Technological Laboratory show that this cotton is suitable for spinning counts up to 20s (warp). It is now being multiplied for distribution. The improved strains of Wagad cotton selected for Upper Gujarat (the closed-boll Dholleras type) are already in demand. The spinning tests at the Technological Laboratory showed that Wagad 4 and Wagad 8 were suitable for 14s and 12s counts warp yarns respectively in 1925-26, and for 16s and 14s respectively in 1926-27. Reference has already been made to the success of Dhulia No. 1 cotton in the Khandesh Division. This cotton is good as regards yield and ginning percentage; it is suitable for 20s counts. The most that can be spun from the local cotton which the new variety will replace is 10s and 12s counts.

In the Karnatak progress has been made in extending the organization for the supply of pure seed of the two existing improved strains, *viz.*, Dharwar No. 1 (Kumpta) and Gadag No. 1 (Dharwar-American) which are already cultivated on a large scale. The

marketing of these improved strains has been carried out mainly through the medium of Co-operative Cotton Sale Societies which also undertook to supply reliable seed. Reference has already been made to the work financed by the Central Cotton Committee for the improvement of the Upland-American type. The Bombay Agricultural Department's Cotton Breeder has achieved very considerable success in the production of types of Kumpta cotton with a higher resistance to the cotton-wilt disease. Promising results are reported to have been obtained at Sakrand with certain Upper Egyptian types of cotton and with certain stapled Americans such as " Acala ". It has also been found that too early sowing in Central Sind is a definite disadvantage, for all flowers opening in the middle of August fail to produce bolls.

In MADRAS, in addition to the work on *herbaceum* cottons to which reference has already been made, the Cotton Specialist's work on the improvement of Cambodia and indigenous cottons was continued. The strain known as Co. 1 (previously Cambodia 295) has proved over several years' tests to be of exceptionally high spinning value: in 1926-27 it was reported to be good enough for 38s warp counts. Another selection, Cambodia 440, though not equal to Co. 1, is nevertheless a good spinning cotton. Moreover, it is a high yielder and much more resistant to " black-arm " and stem-weevil than any other Cambodia selection tried up to date. Work has been continued on hybrids between *indicum* and *cernuum* cottons and between *indicum* and *Roseum* cottons.

At the Nandyal Experiment Station a very thorough comparison of four strains showed that Nandyal 14 maintains its superiority over Nandyal 54: the Westerns strain H. 62 yielded still higher but is of less valuable staple. At the Hagari Experiment Station selection work on both the early and late types of Westerns cotton was continued: the Mungari selection M. 274, which was tested at the Central Cotton Committee's Technological Laboratory, shows promise. Thorough comparative tests of the selections H. 25 and H. 62 indicate that the latter is superior in yield and ginning percentage. As tests at the Technological Laboratory show that there is no appreciable difference in the quality of the cottons, the question of replacing H. 25 by H. 62 is now under consideration. In the 6th (Madura) Circle part of the Koilpatti Experiment Station

has now been specially set aside as a cotton-breeding station and placed under the control of the Cotton Specialist.

Reference has already been made to the research work in progress at Lyallpur in the PUNJAB. The area under American cotton for the 1927 season was slightly below one million acres (being 14 per cent. below the 1926 area), the area under *desi* cottons slightly exceeded a million acres, but in the canal colonies Punjab-American still occupies considerably more than 50 per cent. of the total cotton area. Pure seed of the American and *desi* varieties was issued for about 130,000 acres. This province is particularly fortunate in the existence of a number of large and well-run estates from which pure seed can be obtained in large quantities for general distribution.

Reference has already been made to the research work on *Platyedra gossypiella* (pink boll-worm) in the UNITED PROVINCES. Botanical work for the improvement of the cottons of the province has been continued. A new type known as C. 402 shows considerable promise. It has a staple of about $\frac{3}{4}''$ which is suitable for spinning 18s—20s counts. Its ginning percentage is 39. Seed for about 12,000 acres of the selected short-staple cotton A. 19, to which reference has been made in previous reports, was distributed.

In BURMA, a survey of the indigenous types of cotton was made during the year. The study of the more important commercial characters and breeding work for the production of improved strains by hybridization are being continued. Three of the best strains already isolated have been tested for yield and most promising results have been obtained on a field scale. In the Myingyan Circle an earlier selection of Wagale cotton was grown on slightly over 2,000 acres. In the West Central Circle seed of Cambodia was distributed: but scope for the cultivation of this variety is limited. Several other American types are also under trial. Hardy strains of the local Wagyi cotton are now being multiplied on the experimental farm and other strains are under trial. In the bulk of the cotton area of the circle it is very doubtful whether Cambodia can compete with the indigenous Wagyi variety (*Gossypium obtusifolium* var. *Burmanica*).

In BENGAL, medium staple early-maturing types of American cotton are being multiplied for distribution at the Dacca and Suri

farms. At the Rangamati farm a commencement has been made on the improvement by selection of Comilla cotton.

The selected indigenous type of *G. herbaceum*, known as Sanahatti No. 69, has spread very rapidly in the MYSORE STATE, and attention is now being given to the organization of the seed supply, as it is estimated that more than one-third of the cotton area in the State is now under this type. Experimental work has mainly been directed towards the study of a cross between type No. 69 and *Gossypium arboreum* and to the study of the inheritance of characters of the Mysore indigenous cottons.

The supply of the best available indigenous HYDERABAD Gaorani (Bani) seed has been continued; it is reckoned that the quantity of seed sold was sufficient to sow over 200,000 acres. Reference has already been made to the Hyderabad Cotton Transport Ordinance, the object of which is to stop the importation of inferior varieties for mixing purposes. The system of seed distribution has been improved and the purer stock of true Bani which exists on the Parbhani farm is being multiplied for distribution. Separate auction sales for long-stapled *kapas* have been organized at Parbhani.

As in past years, the BARODA State, in addition to co-operating with the Bombay Presidency in the administration of the Cotton Transport Act, has adopted a similar policy in cotton seed distribution, a matter of very real importance as State and British territories are much interlaced. Seed of the Surat 1,027 variety sufficient to sow 15,000 acres was obtained from the Bombay Department of Agriculture for distribution in the State. Five cotton sale societies are now active and four more societies have been registered for work during the coming season; the five existing societies handled cotton worth over 2 lakhs of rupees. These sale societies are also taking over the work of seed distribution to some extent.

IV. Sugarcane.

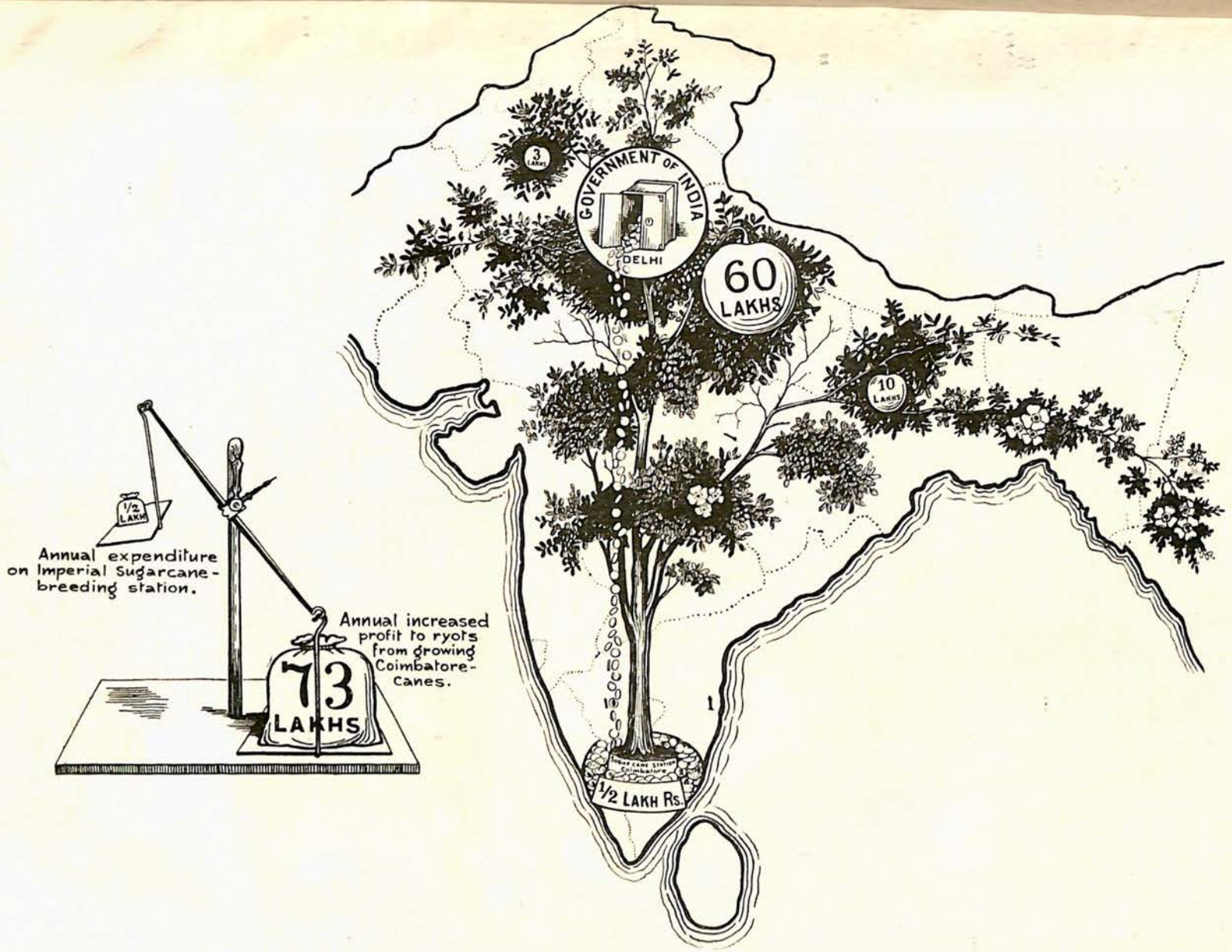
During the year under review weather conditions were generally favourable and the condition of the crop on the whole was good. According to the final general memorandum of the Department of Commercial Intelligence and Statistics, Calcutta, the estimated area

under sugarcane in India was 2,920,000 acres, as against 2,679,000 acres last year, an increase of 9 per cent. The estimated production of raw sugar (*gur*) was 3,208,000 tons, as compared with 2,977,000 tons last year, which is an increase of 8 per cent. This estimate is exclusive of the tracts where cane is grown on a small scale. The average sugarcane area in these tracts for the last five years has been estimated at 151,000 acres and the yield of raw sugar (*gur*) at about 166,000 tons.

The production of refined sugar in India during the year 1925-26 by factories working with cane direct amounted to 52,990 tons, as against 33,805 tons in 1924-25. The output of modern refineries working with *gur* was 38,409 tons in 1925-26, as against 33,593 tons in the previous season. Thus the total production of refined sugar in India both by modern factories and refineries came to 91,399 tons during the year 1925-26, as against 67,398 tons in 1924-25.

During the year under report, imports of sugar into India amounted to 826,900 tons (excluding over 90,530 tons imported through the Indian State ports of Kathiawar) worth Rs. 18,37 lakhs, as against 732,600 tons worth Rs. 15,20 lakhs in the preceding year. After deducting exports, re-exports, and stocks on 1st April 1927, at the principal ports in India, it is estimated that nearly 900,000 tons of imported and locally manufactured white sugar went into the channels of distribution in India in the official year 1926-27, as against 863,000 tons in the preceding year. This is in addition to the raw sugar (*gur*) manufactured locally which, with the exception of some 73,800 tons melted in refineries and 7,600 tons exported, were consumed within the country. There was a rise in the price of sugar from September 1926 to December 1926, after which prices fell again.

The Imperial Cane Breeding Station at Coimbatore continued the breeding of sugarcanes but with a considerable change in the parents used. This change was made, as it was considered that the possibilities of breeding from the older parents had been more or less exhausted. Further improvements were effected in the technique of cane-breeding. The method of isolating live cane arrows, evolved at the station during the previous season, has proved a success. A suitable artificial culture medium for germinating cane pollen has been discovered. This is an achievement of



FIRST FRUITS OF SUGARCANE BREEDING.

PLATE II.

CO. 213 CANE GROWN AT PUSA WITHOUT IRRIGATION.

some importance in view of the previous failures in this direction. Popular descriptions of five of the most widely accepted of the Coimbatore canes were drawn up with a view to helping growers to identify them in the field. The flowering characters of many thick cane varieties were studied in some detail as an essential preliminary to breeding work on this class of canes.

In North Bihar the Coimbatore canes are steadily replacing the indigenous varieties. Many of the growers feel that, but for these new canes with their greatly increased yields, they would have been very badly hit by the low prices for sugar prevalent during the year. Frost of unusual severity in the Punjab damaged some of the local varieties severely : the Co. canes under trial proved more resistant. For seed of these desirable varieties there is a growing demand in this province. In the United Provinces, too, the demand is considerable ; the area has already reached about 44,000 acres.

The work of testing new seedlings was continued at PUSA. Four Java seedlings P. O. J. 2696, 2714, 2725 and 2727 received from the Coimbatore Cane Breeding Station were under trial. As they have shown no signs of being infected with mosaic, they should prove useful parents for cross-breeding. B. H. 10(12), a Barbados seedling, was also grown. It, too, would appear to be immune to this disease. A large number of Co. canes were under trial. Of these, No. 290 is one of the most promising.

In North Bihar, Co. 205, Co. 210, Co. 213 and Co. 214 have been well established. The growers are extending as rapidly as possible the area under Co. 205, a cane which is suitable for poor land and for cultivation under adverse conditions. It is unfortunately somewhat subject to mosaic. The introduction of Co. 210, Co. 213 and Co. 214 in Bihar has to a great extent improved the position of the sugar industry in that tract. The Managing Agents of some of the sugar factories are co-operating with the Secretary of the Indian Sugar Bureau in distributing seed of these desirable varieties. For Co. 214, an early variety rich in sucrose, the factories are paying a premium to growers, as they find that their working season can be increased by about a month by starting off with it before other varieties are ripe. Experiments carried out at Pusa have shown that cane planted in October germinates and tillers better than that planted in February, and that early

planting enables the cane to set a good start. When well established before the hot weather sets in, the crop suffers less in years in which the monsoon is late.

A considerable quantity of seed-cane of the Co. varieties was supplied from Pusa to private growers and Government farms in Bengal, the United Provinces, the Punjab and Burma. Demands for sets were also received from the United States of America and the Philippines. Co. 281 and Co. 213 have done remarkably well on the red soils in Cuba.

The area under these new canes in the UNITED PROVINCES is reported to be about 44,000 acres. In this province Co. 290 would appear to be the best of the Co. varieties under trial. This variety has also done well at Pusa. In his Annual Report for 1925-26, the Secretary of the Sugar Bureau makes the following reference to it :—" Co. 290 is the most promising variety of the new canes under trial. It is a medium thick cane which tillers well and makes vigorous growth. It has stood the prolonged drought very well and has not been affected by mosaic. It will be grown on a large scale for mill trial." In the United Provinces a number of small power-driven mills to work in conjunction with the Bel system of making *rab* were installed with a view to coping with the increased outturn of sugarcane. In Kheri and Hardoi alone, over 9,000 tons of Java canes were crushed in 1927 by small power machinery.

In BIHAR AND ORISSA, the improved Coimbatore varieties are continuing to spread. In years of normal rainfall Co. 213 is the best yielder, except in Saran and parts of Darbhanga District where Co. 210 has done better. Co. 205 has proved a very suitable cane for low-lying lands. This variety was grown last year in a tank on the Cuttack farm which in the rains contained about 5 feet of water. Grown under these adverse conditions, this cane showed no sign of disease and the juice was of good quality. In addition to the large quantity of seed-cane distributed from Pusa, considerable quantities of seed of the Coimbatore varieties have been distributed by the Local Departments of Agriculture and Co-operative Credit.

In the PUNJAB the superiority of Co. 205 remains unchallenged as a cane for unirrigated lands ; for irrigated tracts Co. 223 is com-

ing to the front. In certain villages of the principal cane-growing districts the entire sugarcane area is now under Co. 205. In the Gurdaspur Circle Co. 205 and Co. 223 are rapidly replacing the Uba which until recently held the field: the area in that Circle alone was computed to be about 2,924 acres.

In the NORTH-WEST FRONTIER PROVINCE, Assami Red is considered to be the best of the canes tested up to date. This variety grows vigorously, ripens early and gives a juice of good quality. It is remarkably resistant to disease, too, and suffers but little from borer and other cane pests. Co. 213 has done very well in certain parts of the province but the *gur* made from it is inferior to that made from Assami Red.

Experimental work on cane in BENGAL is chiefly done at Dacca where Co. 213 and Tanna have proved themselves to be the two best varieties under trial. Tanna has been under trial for several years and there is now a considerable area under it in the principal cane-growing tracts of the province. In some districts it has almost ousted the local cane. Co. 213, though a more recent introduction, would appear to be even more promising than Tanna. The McGlashan furnace has proved a success in this province.

In ASSAM, P. O. J. 2714, H. 109, Co. 213 and Co. 210 are among the best of the varieties under trial. To meet the growing demand for improved seed-cane a number of private farms have sprung up in the Upper Assam Valley. During the year under report 184 three-roller sugarcane mills and 52 gur-boiling plants were sold through the departmental seed depôts.

In MADRAS, the main work on cane is being carried out at the experiment stations at Anakapalli, Palur and Samalkota. Round Palur, the variety commonly grown by ryots is Fiji B, but it has now been found that J. 247 and M. 55 give better yields than this variety. It has been found at Palur that ground-nut and castor cake are good manures for cane; but fish guano at present prices is uneconomical. The possibilities of supplementing oil-cakes with artificial manures like ammonium sulphate are being studied. The experimental station at Anakapalli is being extended in area: this station will be used as a testing station for the thick canes produced at Coimbatore. The McGlashan or Sindewahi furnace as it is sometimes called is becoming very popular in the cane-growing tracts of the

Madras Presidency. This improved furnace does not require any fuel other than the bagasse of the cane. It is reckoned that the saving in fuel consequent on the use of this furnace amounts to Rs. 50 to Rs. 100 per acre of cane dealt with. In the Chittoor District 710 McGlashan furnaces are at work. In the IV Circle the department constructed 900 furnaces for ryots in 1925-26 and 200 more in 1926-27. In South Canara on the West Coast the number of improved furnaces now in use is reported to be about 3,000, while the number round Singanallur, the chief cane tract in the Coimbatore District, exceeds 500. It is gratifying to note that this furnace, which was designed by Mr. McGlashan in the Central Provinces many years ago, is now being used by thousands of cane-growers in other parts of India.

In the BOMBAY PRESIDENCY, Pundia still continues to be the most popular of the canes grown under favourable conditions. It gives a large yield of cane and juice of high quality. Owing to the drop in the price of *gur*, cane-growing under the Deccan canals has for the time being become unprofitable except on the best lands.

In the CENTRAL PROVINCES, some of the Co. canes have been found to give much larger yields than Khari—a heavy yielding variety introduced many years ago. Co. 219 has, over a period of three years, given 8,425 lb. of *gur* per acre, as against 4,440 lb. from Khari: the former promises to be a good ratoon cane also. In the Northern Circle, Co. 210 and Co. 237 have done well.

In BURMA, Pyinmana is the station principally engaged in cane work. Of the 10 varieties under trial Gillman is the most promising. Java Hebbal and J. 213 were heavily affected with mosaic.

In MYSORE, the cultivation of H. M. 544 has spread in the chief cane-growing tracts of the State; H. M. 553 has done well in land subject to water-logging.

V. Jute.

In the supply of jute fibre North-East India enjoys a world-wide monopoly. Being an essential requisite of international commerce, the demand for it is governed mainly by the trade conditions of the world in other commodities. With the revival of trade after the depression of the war and post-war period, the crop of 1925 was

found insufficient to meet the world's requirements, and the growers obtained record prices. Thus encouraged, the latter put down 3,847,000 acres in the season under report. This area exceeded that of the previous year by over 16 per cent. and the average for the preceding quinquennium by 59 per cent. With a favourable season, the total outturn of 12,132,000 bales was 35 per cent. higher than that for 1925-26. Over-production resulted in the price dropping to Rs. 5—7 per maund (80 lb.) of fibre, as against the boom price of Rs. 15—20 in the previous year. The total weight of raw and manufactured jute exported increased from 14·6 to 15·7 lakh tons but, owing to the serious drop in prices, the value of exports fell from Rs. 97 to 80 crores.

Over 84 per cent. of the total jute area lies in BENGAL, where two main species are cultivated, *viz.*, *Corchorus capsularis* and *C. olitorius*. A high yielding variety of each of these has been isolated and brought into general cultivation by the local Agricultural Department. The improved strain of the former, namely, D. 154, was isolated for resistance to chlorosis from the well-known Kakya Bombai, while Chinsura Green is the name by which the *olitorius* selection is known. They occupied during the year 500,216 acres or 15 per cent. of the total area under jute in the province. That D. 154 is the heaviest yielder of its kind was demonstrated this year in critical tests at both Dacca and Kishoregunj where it gave 25 per cent. more fibre than the local races. Its yield surpassed that of D. 27 of which at one time high hopes were entertained. The *olitorius* Chinsura Green with its phenomenal yield continued to spread. It has practically replaced the Tosha in Rajshahi. It has invaded even high land tracts in Eastern Bengal which not long ago were considered sacred to *C. capsularis*. Seed of D. 154 and Green Chinsura is being multiplied on the Purnea farm for distribution in the jute tracts of BIHAR AND ORISSA. Seed of Kakya Bombai is being stocked by co-operative banks for distribution through primary societies. Kakya Bombai, R. 85 and Chinsura Green have now an established position in the ASSAM Valley. There is a growing demand for them, too, in the Surma Valley where they have proved the most productive of the varieties tried in the villages. The cultivation of jute is making progress in the Ganjar tract (Kheri and Sitapur Districts) of the UNITED

PROVINCES where conditions are similar to those obtained over large areas in Bengal. The crop of 10,000 bales harvested during the year found a ready market.

VI. Other fibres.

Hemp. The principal source of hemp fibre in India is the leguminous plant *Crotalaria juncea* which is known generally as sann-hemp. It plays an important part in the economics of Indian agriculture as it is also largely used as a green manure. The extension of its cultivation is therefore important, supplying as it does both a cheap but valuable organic manure and a marketable fibre. It is thus a dual-purpose crop. The hemp fibre exported during the year under report fetched Rs. 83 lakhs. At present sann-hemp is grown either for fibre or for conversion into manure : experiments at Pusa have, however, conclusively shown that the same crop can be used economically for both—the tops as a manure and the stems for fibre. Though this necessitates the cutting of the crop three weeks earlier than is ordinarily done when fibre alone is in view, neither the quantity nor the strength of fibre is affected thereby.

Of the eight strains of *Hibiscus cannabinus* isolated at Pusa, Type 3—a tall, unbranched variety—has proved to be well suited to the climate of Bihar.

Rhea, Sida and Agave. Selection work on these fibre crops is engaging the attention of the Bengal Agricultural Department.

VII. Tobacco.

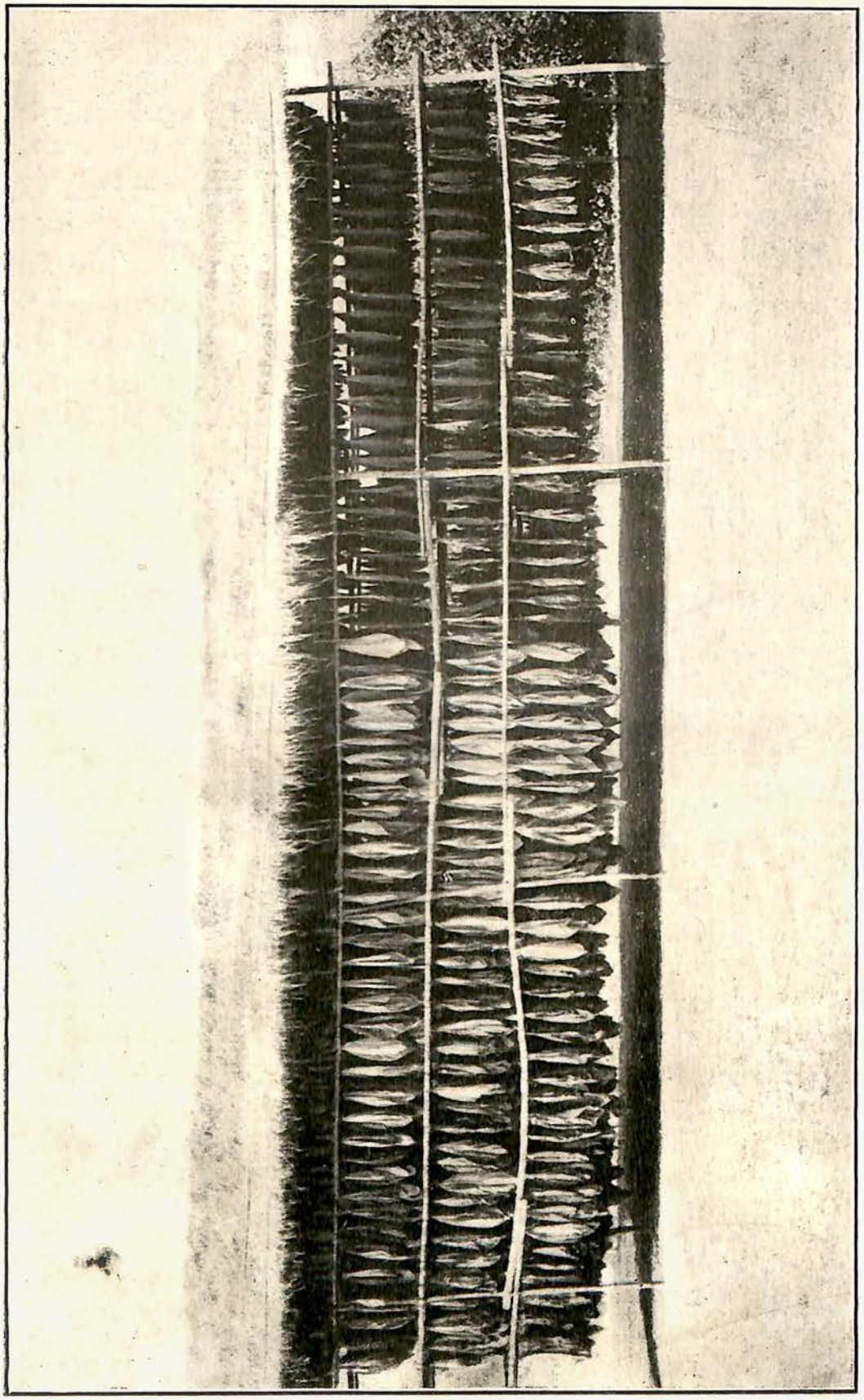
On an average a little over a million acres are cropped with tobacco in India, of which about half the area is situated in Bengal and Madras. The other tobacco tracts of importance are in Bihar, Burma and Bombay. The tobacco mainly grown is *Nicotiana tabacum.* In the drier and colder districts of North-West India *Nicotiana rustica,* a hardier species with a shorter growing period, predominates. The indigenous varieties give a somewhat coarse leaf of low quality which is good enough for *hookas* and *biris,* but a demand has sprung up for tobacco of a better quality for the manufacture of cigarettes. For the manufacture of cigarettes India had to import during the year under review 5·7 million lb.

A PLOT OF WHITE BURLEY TOBACCO AT PUSA.

A PLOT OF ADCOCK TOBACCO AT PUSA.

PLATE IV.

PLATE V.



AIR-CURING OF WHITE BURLEY ON RACKS AT PUSA.

(valued at Rs. 41·5 lakhs) of Virginian tobacco mainly from America. In addition, cigarettes, pipe tobacco and cigars of the value of Rs. 2,13 lakhs were imported. India herself is no doubt a large exporter of unmanufactured tobacco, but on account of its poor quality the 29 million lb. exported fetched only Rs. 97 lakhs. The preference conceded to Empire-grown tobacco in the United King dom has resulted in larger shipments to that country, but an appreciation in value will not follow until there is an improvement in quality. If a tobacco possessing the flavour and smoking qualities of the imported articles could be grown and manufactured in India, there would be a big demand for it both for internal consumption and for export. The programme of the Agricultural Department, therefore, aims at producing a tobacco of the colour, flavour and texture of that which is commonly called Virginian and which will be suitable both for home consumption and export.

Further trials at PUSA with the American tobaccos Adcock and White Burley have shown that a good outturn of leaf can be assured in Bihar by sowing and transplanting them earlier than the indigenous varieties. Sown about the end of July and transplanted in the first week of September, Burley and Adcock yielded, during the year under report, 1,300 lb. and 900 lb. dry leaf per acre, respectively. The former when air-cured on racks takes a rich mahogany colour characteristic of the best grades of pipe tobacco. Flue-curing on a small scale, in a specially constructed tobacco barn, gave very encouraging results with Adcock. The principles governing the use of such a barn are broadly (1) that tobacco must be harvested at the right stage of maturity and consist of uniform leaf, and (2) that the correct moment in the curing process must be selected for raising the temperature of the barn. The burning and smoking qualities of the leaf and the economics of flue-curing are now under study. The second hybrid generation of crosses between American tobaccos and the best of Pusa types (No. 28) yielded about 8,000 plants. Numerous selections were made with the object of obtaining a hardy plant of vigorous growth which would retain the desirable characters of the American parent. Various methods of curing indigenous tobaccos are under investigation in the Chemical Section at Pusa. A sample of Pusa Type 28 rack-cured in the sun and protected from the dew was valued

by an expert as the most suitable for cigarette manufacture.

The acclimatization of exotic cigar and cigarette varieties and the improvement of the local races by selection are in progress at Burirhat in BENGAL. Some of the American types, when flue-cured, were found to give a very fine lemon-coloured leaf suitable for the British market. Firing was also attempted, and some good smelling tobacco for pipe-smoking was obtained. The reputation of the Sumatra leaf grown on the farm as a cigar wrapper has been well established, and there is a good demand for seed. Among the indigenous varieties distributed, Bhengi is most popular, as it is largely used for the manufacture of the well-known Burma torch cheroots. The other two selections are Matihari which is suitable for *hookas* and *biris*, and Naokhol which is much appreciated for chewing purposes.

The superiority of the Bengal selection Matihari over the local varieties is recognized in ASSAM too: its cultivation is spreading in the Surma Valley.

A quantity of seed of Pusa Type 28 is grown on the Sepaya farm in BIHAR for meeting the demand which has arisen in the Saran District where tobacco was not previously grown.

On the newly established tobacco station at Sa-aing in BURMA, a number of American, Indian and Burmese tobaccos has been collected for selective breeding.

Attempts are being made on the tobacco farm at Nadiad in BOMBAY to improve the flavour of indigenous tobaccos by hybridization with American types. A demand has arisen for the seed of Gandiu No. 6 which gives under irrigation an extra value of Rs. 50 per acre.

The cultivation of the American Adcock and White Burley tobaccos introduced by the Indian Leaf Development Co. has spread over more than 5,000 acres in the Guntur District of MADRAS.

VIII. Oil-seeds.

Over 8 per cent. of the total cultivated area in India is on an average cropped with oil-seeds, *viz.*, linseed, rape, mustard, sesamum, castor seed and ground-nut. There was a further shrinkage in the acreage under all other oil-seeds except ground-nut, and the total

area of 19,333,000 acres was lower than that of the previous year by 212,000 acres. But as the acreage yield of linseed, rape, mustard and sesamum was higher than in the previous year, the total outturn of 3,967,000 tons exceeded that of the previous year by 92,000 tons. Owing to the competition of other producing countries, the exports of all varieties of oil-seeds including cotton and *mahua* (*Bassia latifolia*) showed a decrease of 33 per cent., the exports amounting to only 838,000 tons as against 1,250,000 tons in the previous year. The value of the exports amounted to 19,09 lakhs as against 29,64 lakhs in the previous year—a drop of 36 per cent. Though more oil-seeds were left in the country for local crushing, the increased quantity of oil-cakes produced was not all used either as a cattle food or as a manure, as may be gathered from the fact that we sent overseas 236,000 tons of cakes as against 191,000 tons in the previous year and the pre-war average of only 140,000 tons.

Linseed. Crossing between linseeds from Peninsular India and Bihar has given at PUSA types which promise to combine the bold-seeded character with a habit suited for growth in the Gangetic alluvium. Of the pure types previously isolated, No. 46 has proved superior in yield to all the varieties in cultivation in Iraq, and Nos. 12 and 121 in Assam. Type 12 has consistently given on the Sepaya farm in North Bihar 30 per cent. more outturn than the Sabour selection. Of the six types which have survived large-scale tests on the Nagpur farm in the CENTRAL PROVINCES, No. 55 has proved a consistent high cropper.

Mustard. The selection of mustard is receiving attention on the Jorhat farm in ASSAM and on several farms in BIHAR.

Sesamum. Unit species of sesamum are being isolated at PUSA and in BURMA. Among the 25 types selected at Tatkon for high yield of grain and oil, the condition known as " pothe " or " green flower," which is the cause of much loss, has been observed to vary from 1 to 40 per cent.

Ground-nut. The introduction of early maturing varieties of ground-nut has given a great impetus to the cultivation of this crop : the area of 4,292,000 acres sown in the year under report was more than three times the area sown in 1918-19. In Madras and Burma the area has more than doubled in the same period, while the increase in Bombay is of over 400 per cent. In MADRAS,

which carries over 63 per cent. of the total reported acreage under the crop, the problems relating to it are dealt with on a special station at Palakuppam. In varietal tests, the spreading Mauritius variety grown locally has proved inferior to all the other types under trial. It will, it is hoped, be possible to replace it with something better before long. Fifteen years ago the cultivation of ground-nut was practically unknown in the Khandesh and Upper Gujarat districts of BOMBAY. Following the introduction of the small-seeded but early types, this crop became much more popular. It is now grown on an area of over 300,000 acres of land. As it pays much better than the crops which it has replaced, there is every possibility of the area being still further increased.

Similarly in BURMA the area under ground-nut has increased in 20 years from zero to 511,000 acres. To this rapid development the introduction of erect types which are less affected by weeds has contributed in no small measure.

In BIHAR AND ORISSA large yields of ground-nut have been obtained on poor land, and the manuring of the crop with gypsum has proved very effective in increasing the outturn. The extension of the area under this valuable crop is, however, being greatly impeded by the damage done to it by pigs and other wild animals.

As in Bombay, ground-nut has invaded the cotton tract of the CENTRAL PROVINCES. It is grown either in rotation with, or in substitution for, cotton, and regular markets for the nuts are coming into being. In the Western Circle alone, 763 tons of seed of erect varieties were distributed by the department in the year under review, as against only 446 tons in the previous year.

Coconut. The MADRAS department is demonstrating on 205 plots along a distance of 300 miles that coconuts can be raised under a dry system of cultivation, provided that deep ploughing is done in the first instance and that the land is kept constantly cultivated and the top layer stirred during the hot weather to conserve soil moisture. As a result 10,000 acres have been added to this valuable crop on the West Coast on lands which hitherto had lain waste. The possibility of improving the yield of coconuts by hybridization is being explored at Kasargod. Other lines of experiment in progress are manurial trials and spacing experiments. Experience in planting up the new coconut station at Puri in ORISSA indicates

the desirability of transplanting seedlings from nurseries when not more than two roots have come out of the seednut. Coconut gardens have been laid out on the Akyab and Kyaukpyu farms in BURMA, with a view to collecting data regarding improved methods of cultivating the palm in Arakan. The African oil palm is being tried on the former station. In TRAVANCORE, manurial and spacing experiments with coconut were conducted and a large number of disease-resistant coconut seedlings sold from the Alleppey farm.

IX. Tea.

Eighty-two per cent. of the total area under tea lies in Assam and the two contiguous districts (Darjeeling and Jalpaiguri) of Northern Bengal, while the elevated region over the Malabar Coast in Southern India carries 14 per cent. The area of 739,700 acres occupied by the tea bush during 1926 was nearly 2 per cent. larger than in the preceding year. The area plucked rose from 687,700 acres to 694,600, and the estimated yield of 392,918,000 lb. represented an average acreage outturn of 566 lb. as against 529 lb. in 1925. Favourable weather conditions and an almost complete absence of serious blights combined with heavy manuring in recent years contributed towards a record bumper crop. Only 11 per cent. of this enormous production was consumed in the country. The exports, by sea, of 350,502,000 lb., valued at Rs. 29,04 lakhs, were higher than those of the previous year by 7 per cent. both in quantity and value. In addition, 12,379,000 lb. left the country by land. As a result of the high yield the average price realized was slightly lower than in the previous year. The scientific staff of the Indian Tea Association has continued to investigate problems relating to (1) the effect of manures on the yield, (2) diseases and pests of the bush, and (3) the quality as affected by the processes involved in manufacturing tea. Though frequent plucking produces more tea of better quality, it is exhausting to the bush. Drying to a lesser degree than is practised in Ceylon is effective in North-East India, and in the rains conditions for a good " wither " are that 100 lb. of leaf should dry to 75 lb. The main chemical action in fermentation being the oxidation of tannins, the thinner the spread layer of leaf, the greater is the exposure to air and the shorter must be the fermentation. A spraying with a lime sulphur solution has been

found to reduce losses from fungus diseases as well as from the mosquito blight. In Southern India, the crop is dealt with by the scientific staff of the United Planters' Association. At the newly opened tea experiment station at Nellakotta, dusting with calcium cyanide has been found to be an effective remedy against the tea Aphis which infests nurseries. It has also proved efficacious as an insecticide for the *Helopeltis* pest which is responsible for considerable loss in tea gardens.

X. Coffee.

The coffee industry is practically confined to a tract in Southern India, comprising part of the Madras Presidency, Coorg, and the States of Mysore, Travancore and Cochin. The area occupied is in the neighbourhood of 150,000 acres; the quantity of cured coffee produced fluctuates between 20 and 25 million lb. Heavy crops having been obtained all over the coffee tract, prices gradually fell in the year under review, and the exports declined by 27 per cent. in quantity and 28 per cent. in value, *i.e.*, from 205,000 cwt. (valued at Rs. 1,85 lakhs) to 150,000 cwt. (valued at Rs. 1,33 lakhs). The United Planters' Association of Southern India maintains an experimental station at Sidapur which deals with the scientific problems of this crop. Varietal tests on this station having proved the superiority of Kent's hybrid, the area under this type of Arabica coffee is being extended. With the adoption of spraying measures against leaf and die-back diseases, the determination of the most suitable pump has become necessary. Trials with various makes of different sizes have resulted in favour of one capable of dealing with 200 trees in one hour. At the new coffee experiment station established by the Mysore State at Balehonnur varietal and manurial experiments have been started.

XI. Rubber.

Rubber is grown mainly in Southern India and Burma; in the year under review the area amounted to 138,639 acres which is 5 per cent. above that of the previous year. From the area of 101,329 acres tapped, 23,004,167 lb. of raw rubber was obtained, as against 19,970,188 lb. from 93,528 acres in 1925-26. Though the quantity exported to foreign countries (23 million lb.) increased by 3 per

cent., the value (Rs. 2,60 lakhs) declined by 15 per cent. At the rubber station of the United Planters' Association at Aneikulum it has been found that the quantity of Bordeaux mixture required to protect a mature Hevea tree against *Phytophthora*, the fungus which causes secondary leaf-fall, is 3—4 gallons. On areas difficult to spray, heavy doses of urea have been found to mitigate appreciably the damage from this disease. In Burma secondary leaf-fall of rubber was completely controlled on two estates by spraying with Bordeaux mixture. Manurial trials indicate that nitrogen is the principal food constituent required by the rubber tree, and that applications of nitrogenous fertilizers increase the girth as well as the yield of latex.

XII. Fruit.

The Imperial and Provincial Departments of Agriculture have not as yet given much attention to fruit culture. Faced from the very beginning with a shortage of staff, their plant breeders concentrated on the improvement of the staple crops. Some progress has been made, however, in several provinces in testing exotic varieties, different methods of budding and grafting, etc., in Government gardens and in orchards on Government farms. Bombay and the Punjab have recruited a horticulturist, and the Agricultural Officer of the North-West Frontier Province, who is an expert in horticulture, has given special attention to this branch of husbandry.

In the NORTH-WEST FRONTIER PROVINCE, the varieties of plums and peaches selected at Tarnab are now extensively grown. A late apricot, two types of pears and a seedless variety of orange selected in more recent years are also finding favour with the fruit-growers in the Peshawar valley. Over 30,000 budded plants of improved varieties were sold during the year. The crop of the experimental plum and peach orchard planted in 1918 was sold to a fruit dealer for Rs. 4,000. When it is considered that the orchard has about 60 varieties, that not more than half of the trees are of good commercial kinds, and that only 20 of them have been chosen by the department for the fruit trade, Rs. 400 per acre is a good price. It is reckoned that an orchard carrying only improved varieties will on this basis give a gross return of Rs. 1,000 per acre. The fruit farm started by the Howards at Quetta in BALUCHISTAN has greatly

benefited the province and is now being run on a self-supporting basis. Improved methods of budding and nursery management introduced on the farm have spread to private orchards, and the fruit boxes and crates designed have been taken up by the trade. Over 8,000 plants were sold during the year. The newly appointed Fruit Specialist has taken up the selection of stocks best suited to the citrus varieties grown in the PUNJAB. Experiments on the rejuvenation of citrus trees by the process known as "severe heading back" have been started. A fruit preservation laboratory has been established at Lyallpur where short courses in the best methods of converting surplus friuts into jams, jellies, marmalades, etc., will be arranged for growers. Forty-five varieties of grapes obtained from America and some of the highly appreciated mango varieties from other parts of India are under trial. In the UNITED PROVINCES, some of the Government gardens have long been used with good effect for the propagation and distribution of improved fruit trees. A flourishing fruit industry has been built up round Saharanpur; the origin of hundreds of thousands of fruit trees now growing in various parts of the province can be traced to stock distributed from Saharanpur and other Government gardens. The fruit gardens at Coonoor, Burliar and Kallar in MADRAS continue to supply fruit trees to the owners of orchards in the Nilgiri hills where fruit-growing is becoming popular. The improvement of Deccan varieties of guavas and grapes is being attempted in BOMBAY. Subtropical fruit trees such as apricots, peaches and nectarines introduced on the Chhindwara farm have proved to be unsuited to conditions obtaining in the CENTRAL PROVINCES at an altitude of 2,200 ft. Pomological gardens have been laid down on several agricultural stations in BURMA. The Kew pineapple has proved superior to all other varieties tried at Hmawbi. The fruit-growing experiments at Shillong are being continued by Mr. Holder to whom the orchard has been leased by the ASSAM Government. Grafted fruit trees from this garden are in considerable demand in the province. The practice of spraying fruit trees against various diseases and insect pests infecting them is being adopted on an increasing scale. At Pusa, spraying with lead arsenate proved during the year very successful in controlling the ravages of cockchafer beetles on plum trees.

XIII. Fodder Crops and Grasses.

In previous reports stress has been laid on the fact that in every well balanced scheme for the improvement of live-stock in India better breeding and better feeding must be taken up simultaneously. In the past when large grazing areas were available the cultivator relied very largely on Nature to produce food for his cattle in the form of pasture. The vast uncultivated tracts of India admittedly afforded for part of the year abundance of grass. The growth of grasses in India is extremely rapid, however, and they quickly become unpalatable to stock. Permanent pasture lands in the sense in which the term is used in temperate climates do not exist. As the pressure on the land increased, much of the best of the natural grazing land was converted into tillage land, for the ever-increasing human population had to be fed. A set of conditions thus came into being which were inimical to the rearing of cattle on the old extensive lines. The area still available for grazing in British India is reckoned to be in the neighbourhood of 210 million acres, but as already pointed out the grass on much of this area becomes unpalatable for stock soon after the cessation of the monsoon, and no real effort is as yet being made to cut and store the grass as hay or silage at a suitable stage, *i.e.*, before it depreciates in quality. Cattle, over the greater part of India, have in consequence to subsist for about half the year on fodder consisting of dry withered grass in the grazing areas, and the stalks, stubble and leaves of overripe grain crops. Reared under conditions which approach starvation, for their food supply is deficient both in quality and quantity, natural selection has been going on for centuries. The fodder problem is still further aggravated by the fact that a large number of old and useless animals are maintained which impose a severe drain on the fodder supply available. There are far too many half-starved cattle in the country.

To the two main aspects of the cattle problem, namely, breeding and feeding, special attention is now being given in most provinces. Detailed studies are being made of the principal breeds, and improvement is being effected by selection and in some cases by cross-breeding. Moreover, pioneer work of a high order in the study of breeding, feeding, milk-production and disease in their relation to

cattle had been done on military dairy farms before agricultural departments, as at present constituted, came into being, and a body of information accumulated which should be of great value to live-stock experts in the provinces. The Cattle Conferences held at Bangalore in 1924 and at Pusa in 1925 served a most useful purpose in stimulating a live interest in animal husbandry. In every province breeds are being studied, new fodders being tried, and effective methods of conserving them demonstrated on Government farms.

The most valuable leguminous fodder crop introduced by the Agricultural Department is Egyptian clover or berseem. First brought into India some 20 years ago, it is now grown successfully in Sind, Bihar, the Central Provinces, the Punjab and North-West Frontier Province. It is being grown on a large scale at PUSA, where it is followed in the same year by a crop of early maize. The berseem is mostly grazed by tethering the dairy cattle in the field. The soil is enriched to such an extent by the clover that its nitrogen content has been found to be about double that of the best farm land, and large yields of maize are obtained without any manuring on what was formerly rough sandy jungle. By thus cropping a comparatively small irrigated area, a large herd is provided during the winter and summer months with all the bulky green fodder they require. During the rains the Pusa dairy herd is grazed on fields laid down to *kharif* (autumn) pulses such as *guar* (*Cyamopsis psoralioides*) and *meth* (*Phaseolus aconitifolius*). Besides providing the cattle with the green food essential for maintaining a high milk yield soiling has a striking effect on the succeeding cold weather cereal.

In BIHAR AND ORISSA, Elephant grass and Rata grass (*Anthistiria ciliata*) are being successfully grown at Sepaya and Kanke respectively. The heavy yield and perennial growth of the former make it very valuable for planting on odd pieces of land such as embankments where it can be allowed to stand for some years. The latter grown in rotation on cultivated land puts forth a good growth early in the season, is easily cut with a mower, and produces a strong aftermath. The cultivation of the Japanese millet has proved useful as a fodder catch crop on departmental farms in BENGAL, and is now being taken up in the countryside. Elephant grass and Guinea grass are becoming popular in ASSAM, and the

demand from cattle-owners for clumps for planting is being met from the Jorhat farm. The pit silo has proved a success on the Upper Shillong farm, but a type suitable for the plains has not yet been found. Among the exotic grasses, Merker grass appears to be very well suited for the upland laterite soils of Lower BURMA.

The newly appointed Fodder Specialist in the PUNJAB is studying the yielding capacity of various varieties of grasses, oats and turnips. Berseem has replaced shaftal (Persian clover) on 20 per cent. of the area under clover in the NORTH-WEST FRONTIER PROVINCE. It seeds freely in this province and gives larger yields of fodder than shaftal. It is also less liable than shaftal to cause hoven in cattle. Of the different varieties imported from Egypt, Misqawi has proved the best. A large number of grasses and leguminous fodders are under trial on the Nagpur farm in the CENTRAL PROVINCES with a view to obtaining, by the usual processes of plant-breeding, desirable strains and types. Rotational grazing has given good results in Bombay, where methods of renovating poor pastures are under investigation. Methods of storing *juar kadbi* (dried sorghum stalks) on a large scale in years of plenty are also being studied. Over 30 million pounds of *kadbi* was shredded, baled and stored during the year at Karajgi in the Dharwar District. The cost of shredding and baling came to little over Rs. 5 per 1,000 lb. of baled fodder. On the Hosur farm in the MADRAS PRESIDENCY spear grass when cut before flowering has been found to make good silage.

XIV. Millets.

The principal millets cultivated in India are *juar* (*Andropogon Sorghum*), *bajri* (*Pennisetum typhoideum*) and *ragi* (*Eleusine coracana*). Of these, *juar* is the most important, occupying as it does an area as large as that under wheat. Over 86 per cent. of the area under *juar* is in Bombay, Madras, the Central Provinces and the Hyderabad State where the grain forms the staple diet of a large section of the population and the dry stem (*kadbi*) a useful cattle food. *Bajri* and *ragi* occupy on an average 13 and 4 million acres respectively. Selective breeding with *kharif juar* has given at Surat, Dharwar and Larkana in BOMBAY high yielding improved grains which are in demand in the respective areas for which they

are suited. The system of growing *juar* on ridges in black soil tracts liable to water-logging, is being widely adopted in the Surat District; it is reckoned that this improved method increases the yield by over 20 per cent. The selected *juars* under distribution in the CENTRAL PROVINCES are the yellow-grained Saoner, Dhamna, Detha and Lamkansi and the white-grained Ramkel.

The practice of steeping *juar* seed in a solution of copper sulphate as a preventive against attacks of smut is now fairly widely adopted in *juar*-growing provinces. In the Central Provinces, the use of copper carbonate is also recommended; though not so cheap as copper sulphate, the vitality of seed treated with it is not affected by being stored. It has been found possible to check the depredations of the *juar* stem-borer in Bombay by ploughing up the stubble as soon as the crop is harvested and drying the *kadbi* thoroughly before stacking it.

Breeding work on *bajri* subsidized by the Sir Sassoon David Trustees has given in BOMBAY two promising types which give comparatively high yields under drought conditions. At the Millets Breeding Station in MADRAS, both *juar* and *ragi* are under study. Work on the latter has reached the stage of singling out economically promising individuals, and putting them to a comparative trial for yield. *Ragi* H. 22, isolated in MYSORE for high yielding and drought-resisting powers, continues to spread in areas suited to it.

XV. Potatoes.

Although the potato is not indigenous to India, it is one of her most important garden crops. It has become a regular item in the dietary of the middle and upper classes, and the area under the crop is extending to meet the growing demand. There are, however, problems, more especially connected with the supply of seed and the control of disease, which have to be solved before its cultivation can be rapidly extended.

Among the 15 varieties of potatoes under trial on the Upper Shillong farm in ASSAM, King-of-Potatoes once again stood first with a yield of over six tons per acre. In the manurial experiments, cow-dung alone gave the most satisfactory results. Spraying with Bordeaux mixture kept the farm crop free from *Phytophthora*

blight; the disease did considerable damage in cultivators' fields. It is gratifying to know that some of the exotic varieties tested on this farm several years ago, are now being grown on a large scale in the province. As varieties deteriorate in course of time, it is desirable to import fresh seed.

Thikri potatoes from Burdwan, which have been found at Sabour to have better keeping qualities than the local varieties, have been distributed to cultivators in BIHAR. Ammonium sulphate is gradually taking the place of castor cake as a manure for the potato crop.

The programme of the special potato research farm at Farrukhabad in the UNITED PROVINCES consists of (*a*) the control of mosaic disease which has heavily infected the local variety Phulva, (*b*) trials with new varieties, and (*c*) cold storage experiments. Striking results have been obtained by storing potato seed in a cold chamber; when sown, the germination was 100 per cent. and the growth uniform and vigorous.

Scotch potatoes yielded in the SIMLA HILLS 30 per cent. more tubers than the local varieties despite the adverse climatic conditions which characterized the year under review. The effect of underground storage in reducing losses from disease is being tested at Lyallpur.

A number of varietal and cultural tests are in progress on the potato farm at Nanjanad in MADRAS.

XVI. Beans and Pulses.

The exhaustive researches made into the occurrence of prussic acid in the BURMA bean Pebyugale (*Phaseolus lunatus*) have resulted in proving the impossibility of completely eliminating the poison by selection within the variety. The local department has, however, found in the Moki Lima bean obtained from Egypt a promising substitute. Though not such a heavy yielder as the Pebyugale on the poorer soils of the upland, it has been valued in the London market at nearly double the price of the indigenous variety. An attempt is also being made to produce by cross-fertilization a prussic-acid-free type which will suit the upland soils of the dry zone. In variety trials at Padu the wilt-resistant Karachi gram came out an easy first; it has spread over 75,164 acres during

the last five years. Gram Type 4 isolated at Sabour has proved suitable for South BIHAR. Pusa Type 17 has, on the Sepaya farm, proved to be a high yielder. Type 28 isolated in the CENTRAL PROVINCES is reported to give 25 per cent. more outturn than the mixture ordinarily sown in the Southern Circle. The inheritance of qualitative and quantitative characters is under study at PUSA among crosses made between some of the 25 pure strains of grams isolated.

Breeding work on pigeon-pea is in progress at Pusa, Sabour, Nagpur and Mandalay. Natural cross-fertilization takes place in this crop on a large scale, but good progress has been made at Pusa towards the isolation of a pure line type resistant to wilt disease. An effort is also being made at Pusa and at some provincial centres to evolve superior varieties of other pulses (*Phaseolus mungo, P. radiatus and Lens esculenta*) by selective breeding.

CHAPTER III.

RESEARCH AND INVESTIGATION.

In addition to the economic work on crops detailed in the previous chapter, a considerable amount of research work bearing on fundamental problems of agricultural chemistry, agricultural bacteriology, plant pathology, mycology and entomology is being done by the various Departments of Agriculture in India. Among the investigations in progress during the year may be mentioned those dealing with the movements of nitrates in the soil, the conservation of soil moisture, the fixation of nitrogen, the nitrification of manures in the soil, the possibility of producing artificial farmyard manure, the utilization of the sources of natural indigenous phosphate, the influence of manures on the quality of crops, the detection of adulterants in *ghee* (clarified butter), animal nutrition, the mosaic disease of sugarcane, and the control of insects infesting cereals in storage. Although much light has already been thrown on the problems under investigation, it is yet too early to base definite recommendations on the data collected. Some of the outstanding results are briefly noticed below; but for detailed information relating to the research and investigational work in progress, reference may be made to the scientific reports of the Pusa Institute and to those of the provincial research officers.

I. Soils.

Survey of soils. Soil surveys of typical tracts continue to be carried out by several departments. A soil survey of the southern taluqs of Malabar is nearing completion in MADRAS. This tract does not appear to be so markedly deficient in phosphoric acid and lime as North Malabar. In BURMA, the soils of the Mandalay District have been found rich in potash, but lacking in both nitrogen and phosphoric acid. The scientific staff of the INDIAN TEA ASSOCIATION published during the year the results of a survey of the soils of the Terai.

"Unfree" water in soils. The theory that a part of the water in the soil is so bound up that it does not function as a solvent for salts is being examined at PUSA. A method for determining the base exchange capacity of a soil is also under investigation.

Soil acidity. A comparative examination of the numerous methods propounded for the estimation of the lime requirements of acid soils is being made at PUSA in order ultimately to find out a method which can be correlated with agricultural practice. It has been found in BENGAL that in normal paddy fields the hydrogen ion value is nearly neutral, whereas acid or alkaline reactions are obtained when the crop is poor. Well marked cases of acidity are met with in the old alluvium of ASSAM but not on the new alluvium including the *chaur* lands on river banks. Tea, unlike most crops, requires a soil of fairly high acidity. Experiments are now in progress at the Tocklai station of the INDIAN TEA ASSOCIATION to determine safe upper limits of acidity for various tea soils. The usual pH value of these soils is about 5·4, but values as low as 4·0 and as high as 7·2 are sometimes met with.

"Available" phosphoric acid in soil. Alkali soils from Sind, calcareous soils from the Deccan, the Central Provinces and Berar, humus soils from Simla and Mussoorie, and non-calcareous soils from the Central Provinces, Bihar and Orissa, were analysed at PUSA for the estimation of available phosphoric acid both by the potassium carbonate method and Dyer's citric acid method. The former appears to be of greater general applicability and of greater utility for the evaluation of particularly calcareous and alkali soils.

Soil moisture. A very considerable increase in the retentive capacity of the soil has been obtained by green-manuring in the DECCAN where the rainfall is so precarious and irregular that the conservation of soil moisture is the predominant factor in crop production.

Reclamation of saline lands. The best method of reclaiming some 300,000 acres of saline lands in the Montgomery District of the PUNJAB is under investigation at a special station at Harappa Road. The programme of experiments includes flooding either on a single occasion or periodically and applications of gypsum and castor cake. The effect of coating the surface with sand in

the initial stages of reclamation and the possibilities of afforestation are also being investigated. Flooding has resulted in a marked improvement in the physical texture of the soil, and gypsum has caused a slight increase in crop yields.

Cultivation of Deccan soils. Research has been undertaken in BOMBAY with a view to ascertaining the best methods of cultivation on black soils under the arid conditions of the Deccan. The provisional conclusions arrived at in the course of the investigation are that the loosening of the soil in cultivation in black soil, however obtained, has little effect on crop yield. The inversion of soil seems to have some but not a great advantage over mere loosening, but the turning over of soil below six inches deep does not lead to improved growth, whether this increased depth of cultivation be brought about by a blade harrow or a subsoil plough. The loosening does not affect the total water content of the soil, but it does increase nitrification, and while it reduces perennial weeds it increases annual ones.

Movements of nitrates. The study of the movements of nitrates in the soil and subsoil, which had been in progress at PUSA for some years in four areas under different cultural conditions, was concluded during the year. The results obtained point to the conclusion (1) that nitrification becomes very active when the rains begin and soon reaches its maximum, (2) that very considerable quantities of nitrates are, later on, washed into the subsoil and naturally lost, (3) that very little of the large quantity of nitrates produced during the early rains is utilized by the crops grown during that period, (4) that the nitrate produced during the latter part of the monsoon is utilized by the cold weather crops, and (5) that there is no upward movement of the nitrates in the subsoil. Similar conclusions have been arrived at in an investigation at NAGPUR in which the results obtained by the examination of the soil *in situ* were confirmed by analysis of drainage waters and of waters in two conveniently situated wells.

II. Nitrogen Fixation.

An investigation into the fluctuations in the total nitrogen content of different soils at PUSA was started during the year. In

all the five plots of the permanent manurial series examined, the nitrogen content was highest in July, lowest in December, and gradually rose from March to June. The cropped half of a plot generally held about 2 mg. nitrogen less per 100 grm. soil than the other fallow half. Fields in which Egyptian clover and maize were grown in rotation without any manurial treatment, were found to have about double the nitrogen content of the plots in the experimental areas. Laboratory experiments on nitrogen fixation with the addition of various phosphatic manures gave very irregular results.

Further investigations into the bacterial contribution of canal irrigation to the soils in the PUNJAB have revealed the presence of organic and nitric nitrogen in appreciable quantities in canal water. Nitrifying and nitrogen-fixing bacteria are more numerous in the summer than in the winter.

III. Manures and Fertilizers.

If the Indian cultivator is to take full advantage of the improved varieties of crops introduced by the Agricultural Department, an extended and judicious use of manures is imperative. He has yet to learn that by using his cattle dung as a fuel, he is depriving his fields of a very valuable fertilizer, the application of which would enormously increase his outturns. The wastage of nitrogen, the most valuable and, in this country, most necessary of plant foods, by this wasteful practice of burning cattle dung, must be in the neighbourhood of 1,600 million lb. The quantity of oil-cakes available in India, even though none were exported, would not affect crop production to anything like the same extent.

It is sometimes argued that the export from India of oil-seeds and oil-cakes should be entirely prohibited. If all the oil-seeds which are now being exported were to be crushed in India and the cake used as a manure; further if it were possible to use also the considerable quantity of cake which is being exported to other countries, the total quantity thus made available would contain about 110 million lb. of the plant food, nitrogen, which this nitrogenous manure supplies. The quantity of nitrogen required by different crops varies considerably. The average quantity used per acre by all the crops grown in India is probably somewhere

in the neighbourhood of 25 lb. On this basis the 257 million acres cropped in India would require approximately 6,425 million lb. of nitrogen. If the export of oil-seeds and oil-cakes were to be prohibited, and if all the oil-seeds were to be crushed and the oil-cakes derived therefrom used as a manure, the total quantity of nitrogen available from that source would be about 110 million lb. only, or 1·7 per cent. approximately of the total quantity required to produce normal crops.

The quantity of nitrogen thus made available would, in practice, be found to be much less than 110 million lb. for the reason that edible cakes such as linseed and cotton cake are much too valuable to use as a manure. We may take it, therefore, that the quantity of nitrogen that would be available for manurial purposes would be considerably less than even 1·7 per cent. of the quantity required to produce normal crops.

Another point to be considered in this connection is that if the export of oil-seeds were to be prohibited, the area cropped therewith would be reduced very considerably; for a reduction in the demand resulting from the narrowing of the market would cause a drop in prices and the cultivator would in consequence substitute for oil-seeds, crops which paid him better. Any action tending to reduce exports would, in short, result in a reduction in the quantity of oil-seeds and oil-cakes produced in India, and this in turn would result in a reduction in the quantity of nitrogen derived therefrom.

It is very desirable that the Indian cultivator should use manures on a much larger scale than he is doing at present. Much of the arable area has been under cultivation for centuries and has reached or almost reached the state of maximum impoverishment. The soil of such areas gives poor yields mainly because it is deficient in nitrogen, and it is therefore very responsive to the application of nitrogenous manures. In certain tracts the soil is deficient, too, in phosphates, and readily responds to application of manures which are rich in that plant food. But for most of the soils in this country it is nitrogen which is the limiting factor in years of normal rainfall. There are now several fertilizers on the market which supply these two plant foods in a readily available form. By a judicious use of fertilizers in conjunction with farmyard manure

and decomposed organic matter, the impoverished fields of India could be made to give much larger yields. The prices of the former have dropped to a level which makes their use profitable for certain crops, and the agencies and depôts opened throughout the country are gradually placing them within the reach of the cultivator.

Organic manures. The investigation into the possibility of producing artificial farmyard manure has reached at COIMBATORE a stage when it can be demonstrated with advantage to the ryots. Many waste products have been successfully and quickly rotted down by using cattle urine as the starter, and comparative field trials have shown that the organic matter so produced produces results similar to those obtaining by using cattle manure. In TRAVANCORE, a finely divided organic manure as rich as cattle manure in nitrogen and phosphoric acid and richer in potash was obtained by composting water hyacinth and other water weeds with cowdung and ashes. Over 110 tons of artificial farmyard manure were prepared at DACCA during the year from refuse straw, sugarcane trash, and weeds, to which were added cattle urine, byre washings, and a little bone-meal. In the absence of cattle urine, a mixture of cowdung with 20 times its weight of water, or a 1 per cent. solution of sulphate of ammonia with a little bone-meal can be used as an effective starter. Organic manure is being prepared at the Institute of Plant Industry, INDORE, too, by composting weeds and organic refuse with soil, ashes, and a little cowdung to start fermentation. Sann-hemp first withered and then composted with urine earth from the cattle sheds decomposes more completely and in a shorter time than by any other method. It is most essential to aerate the compost heaps thoroughly with wooden ventilators in order to avoid reduction changes and losses of nitrogen. The decomposition of even such hard, woody, fibrous material as cotton stalks can be effected by breaking up the raw material into small pieces, using it in the cattle shed as bedding, and then storing it in pits to which an adequate supply of water is added to keep it moist.

An enquiry into the methods of green-manuring with sann-hemp is being made in the UNITED PROVINCES. The indications are that supplies of nitrogen can be made available in this way

at a cost of 3 annas per pound, as against 8 annas per pound if purchased in the form of the fertilizers now in the market. The method of accelerating decomposition by cutting sann-hemp early in the season and composting it offers a possible solution of the difficulty of employing green-manure with uniform success for *rabi* crops. At PUSA, the ploughing in of only the leafy portions, namely the tops, permits decomposition in the required time and consequently gives higher yields than when whole plants are used. The stalks remaining after removing the tops supply fibre at the rate of 3 cwt. per acre.

Fermentation with soil and charcoal has proved at PUSA to be as effective with *mahua* (*Bassia latifolia*) cake as with mustard cake. The compost is made by mixing 100 parts of cake, 25 of soil, 5 of charcoal and 65 of water, to which a little watery extract of cowdung is added as the starter.

Experiments are in progress in BENGAL to ascertain the best time to apply oil-cake as a manure and the extent to which the rate of nitrification is affected by an application of lime. The results obtained indicate that it should be applied six weeks before the time when the plant makes its most rapid growth. Though equal amounts of total nitrogen were added, castor cake yielded more nitrate than mustard cake, and in both cases the addition of lime increased nitrification.

Experiments carried out at NAGPUR indicate that in black cotton soil possessing very vigorous nitrifying power, concentrations of over 100 mg. of ammoniacal nitrogen are definitely injurious to the process of soil nitrification. Garden soils or soils near the manure pit have, however, been found at PUSA to nitrify still larger quantities of nitrogen. The nitrifying power of a soil, depending as it does on the number of nitrifying organisms present rather than on their physiological activity, can be increased, if required, by a process of activation or by direct inoculation of organisms from a nitrifying culture. In the absence of such artificial aid, when soils of poor nitrifying power receive heavy doses of nitrogenous manures, there are losses of nitrogen from the soil as nitrites and ammonia.

Calcium cyanamide. At PUSA, calcium cyanamide has been found to nitrify as effectively as ammonium sulphate when the

quantity of added nitrogen is only 5 mg. per 100 grm. soil; with 30 mg. there is no nitrification for many weeks though ammonification takes place rapidly. The presence of calcium cyanamide inhibits the nitrification of cake when both are applied in equal quantities of 15 mg. each.

Nitrate of soda. The suitability of nitrate of soda as a manure for paddy has been carefully tested in MADRAS. All results indicate that green leaf is more profitable than either sodium nitrate by itself, or sodium nitrate combined with green leaf. The effect of nitrate in increasing the yield appears to be due to the physical conditions induced by the nitrate radicle. The amount of nitrate in the drainage water varies inversely with the amount of organic matter added to the soil—an observation which appears to be connected with the considerable production of gaseous nitrogen in these soils.

Gypsum. In the *usar* (alkali) patches on the SABOUR farm, the infertility of which seems to be due to an extremely impervious subsoil layer, heavy applications of gypsum have given promising results. With a dose of 43 cwt. per acre, the germination of sugarcane was good in places where even grass could not previously be grown.

Phosphates. Work on the utilization of the natural sulphur-oxidizing powers of certain soil bacteria for solubilization of the phosphoric acid of bone-meal by composting was continued at PUSA. In a compost of bone-meal, sulphur, sand and charcoal the percentage of soluble phosphate increased from 23·5 to 64·2 in 16 weeks. The superiority of the compost to untreated bone-meal as a manure for mustard, oats and potatoes was well marked in the field trials carried out. In TRAVANCORE, too, this method of composting has given highly satisfactory results. The newly appointed Bacteriologist in the PUNJAB has taken up a study of the action of yeast on the availability of phosphorus in bone-meal.

Ammophos may prove an effective substitute for superphosphate and green-manuring with *Sesbania aculeata* for the paddy fields of South BHAGALPUR. A dose of Ammophos so small as 56 lb. per acre has been found a paying proposition for irrigated paddy in the MANDALAY canal zone. Among the various rock phosphates under test at NAWADAH (Bihar), there is one from

Singhbhum which is remarkably free from iron and flourine. The Trichinopoly phosphate has once more failed to give a profitable return when applied to paddy at COIMBATORE in conjunction with green-manure.

Influence of manures on quality of crops. At COIMBATORE the enquiry into the effect of different plant foods on the composition of the resulting produce continues to give interesting results. It is claimed that the seed from a manured crop grows more vigorously, yields better, and possesses more nutritive value than the seed from unmanured crop, and that the seed from a crop treated with cattle manure is similarly superior to that from a crop manured with artificial fertilizers. A study of the roll of organic matter in plant nutrition has shown that, in addition to the usually accepted physical and bio-chemical effects, it has a direct action in supplying some substance which stimulates the crop. Experiments with yeast and extracts of cod-liver oil which are known to supply vitamins to animals have been found to stimulate plant growth. In the PUNJAB an investigation is being conducted, in conjunction with the Deficiency Disease Enquiry, with a view to ascertaining whether there is any correlation between the vitamin contents of wheats produced under different systems of irrigation (rain-fed,well-irrigated, canal-irrigated) but under similar soil and climatic conditions and different types of soils.

IV. Animal Nutrition.

Experiments on the nutrition of growing animals at the Imperial Institute of Animal Husbandry and Dairying at BANGALORE indicate that sorghum silage is eaten as readily as, and produces results in no way inferior to, Guinea grass ; that spear grass silage is consumed in amounts above the maintenance requirement, while hay made from this same grass is not apparently a palatable diet, and that spear grass silage when supplemented by a small amount of cake is an economic productive ration. Mineral balance experiments with calves showed that they were in great need of lime at the beginning of the feeding trials and assimilated it freely. As the experiment progressed, the rate of lime assimilation decreased. At Karnal, rice straw again proved superior to wheat straw as a fodder, though the latter is more appreciated by culti-

vators. The digestibility of various coarse fodders has been ascertained to be nearly proportional to the percentage of protein they contain. Experiments have been initiated to determine the digestibility of typical samples of Indian hay, the progressive changes occurring in the mineral and organic constituents of pasture grasses during maturing, and the mineral requirements of Indian animals. The results of an investigation into the feeding value of grass hays at LYALLPUR did not confirm the general view held by the military authorities that the hays from the plains are in all cases better than those from the hills. The nutritive values of natural pastures and of fodders grown on different kinds of soils in the Punjab are also being investigated.

V. Sugarcane.

Ripening tests of sugarcane manured with ammonium sulphate or superphosphate are being carried out at SABOUR in Bihar and Orissa, and a more extended test has been completed at PUSA. Of the various manures experimented with at Pusa, superphosphate produced canes the juice of which had the highest sucrose and the lowest glucose content. This result was also reflected in the quality of *gur* (raw sugar) prepared. In Bengal, timely irrigations seem to have a great influence in reducing the glucose content.

VI. Milk and Milk Products.

A systematic analysis of the milk of selected cows of the PUSA herd has shown a gradual rise in the fat content with the progress of the lactation period. The milk from a pure bred Montgomery cow reached a maximum of 9·2 per cent., while that from a cross-bred Ayrshire-Montgomery 8·6 per cent. While the relation between the plate counts and the season of the year has been further established by bacteriological examinations of the milk supplied from the Pusa dairy, a considerable reduction in number has been noticed since the introduction of sanitary milking pails in place of the old open type.

A reliable method of considerable practical utility has been worked out at Pusa for the detection of adulteration in butter or *ghee* particularly with animal fat. It is based upon the practical

precipitation of glycerides of the higher fatty acids from a solution in dry acetic ether by alcohol of defined strength under strictly controlled conditions of concentration and temperature. The experiment has been extended to butter and *ghee* produced from animals fed on various concentrates, with a view to determining whether any of these feeds have a tendency to vitiate the accuracy of the test.

Milk casein, which is largely used in the manufacture of " foods " for invalids and children, is being studied at POONA with a view to ascertaining the difference in the composition of samples obtained from cows' milk and buffaloes' milk, especially as regards the various amino acids and their digestibility.

VII. Diseases of Crops.

The practical methods adopted for combating the ravages of the diseases attacking the more important crops have been indicated in the previous chapter. It is proposed to deal here with such investigations as have not yet reached the stage of practical application.

In connection with the investigation undertaken at PUSA with a view to elucidating the factors affecting the pigeon-pea wilt problem, a further experiment has been laid down in order to test the rate at which wilt spreads in (*a*) unmanured land and (*b*) land manured with superphosphate.

A further survey made at Pusa of the sugarcane-growing stations in different parts of India has revealed the presence of mosaic disease in 28 localities among 47 Co. canes and 2 thin and 38 tropical varieties. Investigational work carried out during the year indicates that the disease behaves in India as in other countries ; that it is transmissible by sets and injection into the leaf and leaf-sheath ; that it passes from one variety to another and from cane to maize and sorghum, and that natural infection occurs. Observations made on a plot planted with mosaic and non-mosaic sets of the Coimbatore seedling 213 suggest that roguing should be done in Bihar as early as the 1st of May when 75 per cent. of the mosaic plants should be visible. Red Mauritius canes grown from seed from a very highly infected block in Sabour were only about 3 to 4 feet in length, while several other varieties

in the same plot were from 6 to 8 feet in stature. Data collected during the year indicate that there is also a possible loss through lower germination in mosaic cane.

A disease of betel-vine, which is causing a loss of several lakhs per year in the plantations of Bengal, has been ascertained at Pusa to be due to the parasitism of a species of *Phytophthora*, *Rhizoctonia solani* and *Sclerotium Rolfsii*. The relative importance of the part each fungus plays is still obscure, but it is most probable that the *Phytophthora* is the active agent during the monsoon, the *Rhizoctonia* in the cold weather and the *Sclerotium* in the hot weather.

Piricularia oryzæ, the fungus which causes paddy blast, is under study at Coimbatore in MADRAS. It appears that there is a constant relative variation in resistance among different varieties of rice, and that excessive doses of nitrogen render the plants susceptible to attack. The source of *Orobanche* seeds in uninfected fields of tobacco has been ascertaind to be goat manure ; pots treated with cattle manure and artificials did not develop the parasite. The stem-bleeding disease of areca palms, as in the case of coconut palms, has proved amenable to the excision of diseased tissues and the application of hot tar as a wound antiseptic.

Experimental data collected at Dharwar in BOMBAY suggest that a high percentage of organic matter reduces the number of deaths from wilt among cotton plants, and that by a suitable system of cultivation during the hot weather the temperature of the surface soil can be raised sufficiently to kill off the fungus. At Surat the problem of boll-shedding in cotton is being attacked by regulation of the moisture in the soil in the latter part of the season. The relative part played by insects and by mildew in the blight which takes such a large toll of the mango crop in the Presidency has been determined, and rational methods of control are being developed.

Further investigations carried out in the CENTRAL PROVINCES are reported to have confirmed the opinion previously expressed that the disease known as wilt of cotton is of physiological rather than of fungoid origin. A *Phytophthora* disease of betel-vines and diseases attacking stored potatoes are among other subjects under investigation.

The red cotton bug *Dysdercus cingulatus* has been proved in BURMA to be the carrier of the internal boll disease of cotton which is caused by *Nematospora coryli* and *N. gossypii*. These fungi have also been found on four other species of wild and cultivated plants.

In TRAVANCORE, various diseases of the coconut palm are under investigation, while in MYSORE preliminary trials have shown that alum-Bordeaux mixture, though cheaper than lime caseinate, is equally effective as a spray against *Phytophthora arecæ*.

VIII. Insect Pests.

The measures adopted against important pests of field and garden crops have been referred to elsewhere and need no recapitulation. A large number of useful observations relating both to the behaviour of insects known to affect crops and of their parasites, has been made at Pusa and in the provinces. These are referred to below.

Experiments are in progress at PUSA to determine which of the four suspected sucking insects is responsible for the spread of mosaic disease among sugarcane. Work on cane-borers and their parasites was continued and a revision made of the specific identity of the species concerned. Whilst examining cane stubble for hibernating borers, a new Aphidid was found on cane roots, which has been identified as *Geoica spatulata*. Large numbers of *Myllocerus maculosus* and *Chætodacus cucurbitæ* were bred out with a view to obtaining parasites. Though success has not attended the attempts with the latter, it is known that this fruit fly is parasitized in other parts of India where were obtained specimens of *Opius fletcheri* which has been introduced into Hawaii with very beneficial results. The use of mercury in stored wheat has proved effective in eliminating the danger of damage by weevils (*Sitophilus oryzæ*) which amounts at times to 20 per cent. The physiological effect of mercury vapour on stored wheat is now under investigation.

A close study of the pink boll-worm (*Platyedra gossypiella*) of cotton, the paddy stem weevil (*Schœnobius incertellus*), the sorghum fly (*Calocoris angustus*) and mango hoppers was continued in MADRAS. A spray of Bordeaux mixture at the time of the

appearance of the flower, followed by a couple of sprays with fishoil resin soap where hoppers are noted, seems sufficient to save the mango crop in most years.

The investigation of the pink boll-worm attack, which is responsible for the loss of 20—40 per cent. of the cotton crop in the UNITED PROVINCES, continued to be the main work of the provincial Entomologist. A large-scale experiment on a block of 400 acres has shown that complete freedom from boll-worm can be obtained if the seed is heated to a temperature of 140°F. for a few minutes before sowing. On a modest estimate the cultivators whose seed was treated benefited to the extent of Rs. 30 per acre, while the cost of heating was approximately one anna per cwt. of seed used.

In the PUNJAB, a study of the incidence of the pink boll-worm of cotton (*Platyedra gossypiella*) is being made with a view to correlating it with the climatic factors. The influence of environment on the life-history of the red cotton bug (*Dysdercus cingulatus*) is also being investigated. The effect on the germination of wheat, gram and maize, of fumigating grain godowns with potassium cyanide at the rate of one ounce per 100 cubic feet space is under study.

The red cotton bug having been observed in BURMA to be parasitized by *Antilochus coqueberte*, a study of the latter's life-history has been taken up.

IX. Useful Insects.

Bees. The Entomological Section at Pusa continued to deal with enquiries relating to apiculture and to supply improved hives and foundation-combs. There is a constant demand also for smokers and excluder-sheets, but there seems to be no source of supply in India for such apparatus.

Lac. At the Lac Research Institute at Ranchi, attempts are being made to devise means of recognizing the sex of the lac insect in the larvæ by field tests, and to select species with a view to evolving a type which will produce resin of a superior quality. Observations on the predators and parasites on the lac-insect were continued, particular attention being paid to the life-history

and seasonal appearance of the Noctuid moth (*Eublemma amabilis*) which is responsible for considerable damage. A bio-chemical investigation of the food constituents of host trees at various ages, and studies of the insolubles in lac and shellac, of the physical properties of shellac solutions, of the constituents of synthetic lacs and new process shellacs are also in progress.

Silkworms. With the opening of a new centre at Bolpur, there are now 12 nurseries in BENGAL for rearing disease-free seed of Nistari and Chotopolu races of silkworms. The spread of tested seed has reduced the losses from pebrine to a minimum, but flacherie continues to levy its toll. Intercrossing of different strains is being resorted to for breeding in resistance to this disease. The effect of extensive demonstrations carried out during the year is to be seen in the increased sales of sulphur and other disinfectants and the improvements made by rearers in their houses. Six students passed out of the Berhampore and Rajshahi sericultural schools, which provide a vocational training for sons of professional rearers.

In BIHAR AND ORISSA and MADRAS, the Department of Industries, which is in charge of sericultural work, is supplying disease-free seed and testing methods of reeling silk. Over 16,000 layings of tested seed were distributed from the Coonoor silk station to the rearers in the Kollegal Taluq of Madras. The hybrid worms obtained at Coonoor by crossing the univoltine French with the multivoltine Mysore worm are in the tenth generation; the rearers to whom they have been supplied find an appreciable increase in the size and yield of cocoons.

In the PUNJAB, 1,717 oz. of silk seed was distributed amongst 980 rearers and rearing was carried out in 150 villages in 18 districts and in 147 schools. The filature started at Sujanpur with a view to helping the rearers to obtain a fair price for their produce, reeled over 16 cwt. of silk yarn. Nearly 20,300 new mulberry seedlings and cuttings were planted on canal banks, and 23,800 were distributed among private persons and schools.

Nearly 30,000 seed-cocoons and 1,400 layings of eggs were distributed from the Maymyo nursery in BURMA. Another departmental nursery is being established in the Prome District, while help is being given to missionary bodies in starting two similar centres in the Tavoy and Toungoo Districts.

Over five lakhs of layings issued from 4 State grainages in MYSORE represented an increase of 27 per cent. over the figure for the previous year. The 75 selected rearers who are working under departmental control were supplied with disease-free layings free of cost: they produced about 7½ million seed-cocoons. The demand for the new races and hybrids evolved is on the increase; they formed 33 per cent. of the total issues from grainages. The State filature produced 17 cwt. of silk and 9 cwt. of silk waste all of which was readily sold in the Indian market. Twenty-six students were trained during the year in silk-reeling and 50 in silk-rearing. A sericultural "bias" has been introduced in three middle schools of the Education Department.

CHAPTER IV.

AGRICULTURAL ENGINEERING.

Outside Lower Burma, Assam, Eastern Bengal and the Malabar Coast (including the Konkan) where the rainfall is ordinarily heavy, crop production in India will always be precarious where irrigation facilities are not provided. Such protection is at present available from canals, tanks, wells and other sources for 50 of the 256 million acres under cultivation in British India. In the area of about $16\frac{3}{4}$ million acres irrigated by lift irrigation from wells and other sources such as rivers and *nullahs*, the Department of Agriculture is particularly interested. **Well irrigation** is most important in the United Provinces where it is used in more than half the total irrigated area. Most of the irrigation from rivers and *nullahs* is done in the United Provinces and Bihar and Orissa. The possibilities of the extension of irrigation by lift are enormous. The pity is that so little has as yet been done to develop this source of irrigation. The important work of putting down tube-wells and increasing the efficiency of existing ones is being carried on by the Engineering Sections of some of the Provincial Agricultural Departments, as will be gathered from Appendix IV, but the staff available for this class of work is lamentably inadequate and the results are therefore proportionately small.

In BOMBAY, 193 bores were put down by the department in the year under review, of which 113 were successful. The staff employed by the department for land development work prepared 415 schemes for field embankments. In the UNITED PROVINCES, 65 tube-wells were completed during the year. Of the 1,017 shallow borings made, 759 were successful. Consequent on the strengthening of the engineering section of the department in the PUNJAB, the number of bores sunk rose to 584, of which over 80 per cent. were successful. Of the 254 strainers used, 249 were of the stoneware pattern designed by the Agricultural Engineer. Further improvements carried out in the manufacture of these strainers have resulted in an increase of 20 per cent. in the water-way area and a reduction of 25 per cent. in cost. Of the 184 borings made in BIHAR AND ORISSA,

only 5 failed to give satisfactory results. The successful installation of seven tube-wells, each giving a discharge of 12,000 gallons per hour, has created a good demand for them. Five hundred and eighty-four wells were successfully bored in MADRAS by the Industries Department to whom this work is now entrusted. Of the 56 bores sunk in BARODA, 37 were successful.

The designing and testing of **agricultural implements** is another line of agricultural engineering in which the department has done some useful work ; most of the improved iron ploughs now being used in India are the handiwork of trained specialists sent to India by English firms. Assisted by experienced officers of the department they were able to design ploughs suitable for Indian conditions. Though the merits of these ploughs are appreciated, their initial cost is standing in the way of their adoption on a large scale. It is reasonably certain that the standardization of types and spare parts combined with mass production would do much to popularize their adoption. The selling price could thus be lowered, the replacement of worn and broken parts simplified and technical difficulties in operation reduced to a minimum. Other implements for which a large demand is bound to follow, in consequence of similar arrangements, are drills, fodder cutters, threshers, winnowing machines and small power cane mills. A perusal of the statement given on page 126 will show that there is already a considerable demand for certain classes of improved implements. A cultivator, a ridge plough, and a plough for deep cultivation designed on the Sepaya farm in BIHAR are under trial. A double mould-board plough, some new types of blade-harrows and a wind-power screw water-lift are among the new implements under trial in BURMA. For the improved ploughshare designed by the Agricultural Engineer of that province and known by the name of Theikpan there is some demand ; arrangements have been made with the Forest Department for the manufacture on a large scale of a complete plough minus the pole for selling at the cheap price of Rs. 7-8-0. At the COTTON BREEDING STATION AT COIMBATORE, an improved method of yoking two pairs of bullocks in tandem fashion has been designed. A pulley block is attached to the implement ; one end of the chain is fastened to the yoke pole of the hind pair of bullocks, passed over the wheel of the pulley and

carried forward underneath the hind yoke to the yoke pole of the front pair. By this means uneven draught is avoided, sore necks are eliminated and labour is saved. At the INSTITUTE OF PLANT INDUSTRY, INDORE, another arrangement has been devised to the same end. The yoke, which is long enough to permit four bullocks to walk abreast, is attached to the implement by a strong chain of suitable length : the line of draught passes through the centre of resistance of the share. Under this system, too, loss of power by non-co-operation is eliminated ; the animals working together exert their maximum power. A power threshing machine imported by the UNITED PROVINCES Department of Agriculture is to be used for threshing the wheat crops of cultivators. Its capacity is 70 cwt. per working day of 10 hours, and the working cost, inclusive of interest and depreciation, is about As. 9 per maund of 80 lb.

The small low power **motor tractors** first imported into this country proved useful for light and shallow cultivation on large estates where a considerable area had to be cultivated at certain seasons in the minimum time. In heavy soils where cultivation by three bottom ploughs was attempted, they were not equal to the task and breakdowns from overloading were of frequent occurrence. It was impossible under these conditions to keep them in good working order. Types strong enough to pull three bottom ploughs have, however, now come into the market, and the experiments made with them in Bihar, Bombay and the Punjab are very encouraging. These do much more work per day and at a lower cost, and are easily kept in working order. There is much scope in India for the use of mechanical power in cultivation but progress in this direction will be slow until and unless repair shops, fully stocked with spare parts, are organized and qualified drivers and mechanics trained to repair and handle both the tractor and the implements worked by it. The steam tackle purchased by the Agricultural Department of the Central Provinces for reclaiming *kans*-infected land has created such a demand for its services that sufficient work will be found for it in the Jubbulpore District alone for some years to come. During the short period that it worked in the year under report, 267 acres were ploughed up to a depth of 10 inches at the contract rate of Rs. 17 per acre. Hand-digging would have cost about Rs. 80.

CHAPTER V.

DISTRICT WORK.

The primary object of agricultural research is to evolve improvements which will benefit the cultivator. Such research is of no value to the country unless the results achieved by research work are actually applied. To get them applied they have to be demonstrated in the most effective manner possible, namely, by ocular demonstration. Descriptions in the abstract do not appeal to the bucolic mind. Agricultural Departments throughout India are therefore paying more attention every year to the organization of demonstration work in the villages and under village conditions. They believe that the demonstration plot or farm worked by the cultivator himself is a much more effective object lesson in improved farming than Government demonstration farms can probably be. Private seed farms fall within the same category in the provinces in which they have taken deep root: they serve the purpose of village demonstration farms. At the ploughing matches now being held regularly in some provinces the advantages of the improved ploughs belonging to the competitors who take part therein are impressed on the minds of the unfortunate competitors who compete at a disadvantage with primitive *deshi* ploughs. An object lesson of this kind appeals very forcibly also to the many visitors who attend such competitions, and frequently results in their ordering on the spot improved ploughs of the type used by the prize-winners.

In most provinces lectures illustrated by lantern slides are given on the improved methods recommended by the local department. To illustrate such lectures cinema films are sometimes used with good effect. Much more attention is being given also to agricultural shows. The two most recent innovations are travelling cinemas and demonstration trains. The first demonstration train organized on the East Bengal Railway visited 30 stations; it is estimated that 90,000 people frequented the train and that 120,000 were present at the cinema and lecture meetings held in the evenings.

The success attained in bringing millions of acres under improved varieties of crops has already been referred to elsewhere. The

figures for the sale of implements and parts of implements through departmental agency in Appendix V (p. 126) are not so striking, but they do not represent the real extent to which these are being taken up by the cultivator. A substantial private trade in implements has sprung up and it is impossible for the departments to keep a record of the sales. During the year under report implements of the value of Rs. 17,00,000 were imported from foreign countries. This figure alone represents an increase of 33 per cent. over the pre-war average. Moreover, many indigenous firms have in recent years begun specializing in the manufacture of improved designs : the number of iron cane mills made and sold in the country every year runs into many thousands, while one manufacturer alone sells 15,000 ploughs annually.

Fertilizers are now being used in the country on a larger scale than formerly. During the year under report, manures of the total value of Rs. 35,40,000 were imported, as against Rs. 11,54,000 in 1922-23. Similarly a larger percentage of the manures produced in the country such as sulphate of ammonia and oil-cakes is now consumed in the country. Ninety per cent. of the artificials used at present goes to tea, rubber and coffee estates, but the organization created by the Indo Agri., Ltd., for the sale of sulphate of ammonia and other fertilizers should in course of time create a demand for these manures for such valuable crops as sugarcane, cotton, tobacco and potatoes. At the depôts opened by this company, fertilizers can be obtained in small quantities at a fixed rate ; the co-operative societies and other agencies allow credit for sales to approved customers.

In BOMBAY, propaganda and extension work are being carried out as a combined effort of the Agricultural and Co-operative Departments and are being directed by Divisional Boards of Agriculture which are predominantly non-official. These Boards work through overseers of the Agricultural Department, and agricultural organizers of the Co-operative Department. These official agencies are supplemented by taluq development associations which are subsidized by Government and in some instances by District Boards. Since 1922-23 when the first association was formed, their number has increased to 74. During the year under report, these associations were engaged mainly in extending the use of

improved implements and seed, and methods for the prevention of smut in *sorghum*. They have organized shows, promoted the formation of non-credit co-operative societies and pushed small irrigation projects. For the supply of seed, the department controls large areas in selected parts of the Presidency. The most elaborate organization for seed distribution is in Lower Gujarat where the quantity of cotton seed distributed amounted to 2,880,000 lb. The Government zemindari maintained in Sind for producing cotton seed supplied 175,500 lb.; in addition nearly double this amount was collected from authorized seed growers and distributed. For demonstration purposes special farms are not maintained: improvements are demonstrated in cultivators' own fields. The most noteworthy event of the year was the holding of the first Presidency Agricultural Show at Poona which was visited by 201,116 people.

The MADRAS Agricultural Department has a staff of 112 demonstrators who paid during the year 13,720 visits to villages of which 369 were visited for the first time. The demonstrations carried out were mainly on agriculturists' own plots on which seeds, implements and cultural methods recommended by the department were contrasted with those commonly used in the villages. In some localities co-operative societies were induced to demonstrate agricultural improvements, under the guidance of the Agricultural Department. The use of green manures for wet land occupies a prominent place in the extension work of the department; 118 tons of sann-hemp, *dhaincha* (*Sesbania aculeata*) and wild indigo seed were distributed. Artificial manures are also gradually coming into popular favour; it is estimated that something like 422 tons of ammonium sulphate and 557 tons of superphosphate were used in the Tanjore delta alone. The McGlashan *gur*-boiling furnace, which is calculated to add almost Rs. 100 per acre to the net profit on cane cultivation, has made such a popular appeal that at least 3,000 are working on the West Coast. The spraying of garden crops against various diseases and the use of copper sulphate as a preventive against sorghum smut are other lines of work which have appealed to the cultivators. The Co-operative Trading Union at Pattambi had stocked this year enough material to spray 16 lakhs of trees.

In BENGAL, a portion of each Government farm is reserved for demonstrating the use of improved seed and methods of cultivation. A few purely demonstration farms have also been started, on which departmental crops are grown by departmental methods through ordinary cultivators who are paid in kind. This method of demonstrating improvements is considered to be the cheapest and most effective tried up to date. One such farm at Kishoregunj has been instrumental in increasing the area under sugarcane in the locality from a few hundred to 12,000 acres in four years; seven-eighths of the area under jute in the neighbourhood of this farm is now being sown with departmental seed. More than 100 private farms belonging to leading zemindars and Khasmahal and Court of Wards estates are being cultivated on lines recommended by the department. In spite of the low prices paid for jute fibre in the year under review, the quantity of improved seed disposed of was greater than in any previous year. The contribution of Rs. 20,000 by the London Jute Association helped the distribution of seed in many new localities, and it is estimated that the campaign will result in the introduction of Dacca selections over 100,000 acres. The Indian Jute Mills Association is also helping in the spread of improved varieties by guaranteeing against loss the agent appointed by Government to sell jute seed up to a maximum of 2½ lakhs of rupees. The establishment of paddy seed farms is being gradually extended in co-operation with the Co-operative Department, and there are now about 300 such areas in the province.

Owing to the paucity of staff, extension work in BIHAR AND ORISSA is restricted to the neighbourhood of departmental farms and to areas in which the co-operative movement is well developed. The Co-operative Central Banks not only stock improved seed and fertilizers for distribution, but arrange through primary societies to demonstrate their value. Improved methods of sugarcane cultivation were demonstrated by 50 co-operative societies in North Bihar, while the Central Banks in South Bhagalpur undertook to have the manurial value of Ammophos demonstrated by about 350 societies. In Chota Nagpur, the Ranchi society and the Khunti Union purchased 20 tons of ammonium sulphate and 10 tons of gypsum for the use of their members.

The prominence given to the financial aspect of the working of the 17 seed and demonstration farms and plots in the UNITED PROVINCES is said to have encouraged an increasing number of persons with capital or land, or both, to take up farming on modern lines. With an increase of 134 during the year, there are now 755 such farms in the province. Of these, 131 are of 100 acres and more. Since April 1925, State-aid is given to private farms opened in localities where the department requires an agency to carry its message. At the end of the current financial year 54 farms in 26 districts will have received grants-in-aid amounting to Rs. 1,20,750. These State-aided and private farms serve both as seed depôts and demonstration centres. As in previous years, demonstrations with improved crops, implements and manures were carried out on a large scale on cultivators' fields, and it is estimated that an additional area of 122,000 acres has been brought under the influence of the department. While the number of seed stores increased from 127 to 148, the quantity of seed sold therefrom rose from 3,890 tons to 8,395 tons—an increase of 116 per cent. The department also sold 9,214 implements and 470 tons of manures.

Of the 17 seed and demonstration farms in the PUNJAB, all but two showed a profit on the year's working. Only seven of these are departmental farms, but sanction has been accorded for the opening of 16 hundred-acre district farms and of two seed farms of the total extent of 1,500 acres. Over one-third of the 1,500 tons of wheat seed and 1,150 tons of cotton seed sold from departmental depôts, came from three large private farms. Two more such grants of 2,500 acres each are to be made in the new Nili Bar Colony. Such farms when properly managed serve a dual purpose. They show how large estates should be run in order to give the greatest net profit, and they serve at the same time the purpose of seed farms. Several grants of smaller areas suitable for peasant farmers are to be made with the same end in view. The department runs several hundreds of demonstration plots on land belonging to cultivators; these plots deal with the use of better implements and the sowing of good seed. There are also 99 "better farming" societies organized on co-operative lines, each of which is composed of a number of cultivators who have undertaken to farm their lands in accordance with the advice of the Agricultural Department. The large

number of ploughing competitions arranged during the year increased the sales of ploughs by almost 50 per cent. Campaigns were organized for the destruction of rats and to deal with the swarms of locusts which invaded the province in the year under review.

Nearly 9,000 tons of seed and a million whole canes were distributed from 14 departmental and 8,770 private seed farms in the CENTRAL PROVINCES. The distribution of improved seed in the Northern Circle is carried out by Tehsil Agricultural Associations, which undertake on the joint responsibility of all their members to return the quantity with 20 per cent. added. Of the 5,635 implements sold in the province, 4,474 were ploughs; the increase in the number of spare parts disposed of from 4,397 to 7,618 indicates that the implements purchased are being used. The district staff carried out 3,446 practical demonstrations and gave 54 illustrated lectures. By the establishment of 26 demonstration plots in various parts of the province, the department has been able to expand its work into tracts formerly untouched; the satisfactory financial results obtained on these plots have encouraged some of the large landholders to carry out similar demonstrations in their own localities. The extension work of the department continues to be ably supplemented by non-official bodies such as agricultural associations, seed unions and co-operative shops.

Of the 151,787 acres cropped with departmental seed in BURMA, 141,138 acres were under improved strains of rice. With a view to meeting the growing demand for paddy seed, land for five new Government seed farms were acquired during the year. The distribution of seed is carried out mainly through co-operative societies and agricultural unions. In each union there are one or more seed farms which multiply pure strains for distribution to the members thereof. Some hundreds of demonstrations were conducted during the year on small plots placed at the disposal of the department by cultivators or rented for the purpose. The Agricultural Improvement Committees, representative of leading landowners and cultivators, formed in certain districts are very helpful in spreading the improvements recommended by the department. Some of the larger landlords now insist on their tenants growing pure seed supplied by the department.

Seeds, manures and implements of the value of Rs. 69,974 were sold from the three depôts in ASSAM. The most important of the articles supplied were 136 tons of potatoes, 55 tons of bone-meal and 185 sugarcane mills.

Seed of Pusa 4 wheat, Red Assami cane and berseem was distributed in the NORTH-WEST FRONTIER PROVINCE as far as the resources of the Tarnab and Haripur farms would allow. The number of budded plants of improved peaches, plums, apricots and pears sold was nearly 30,000.

A large number of co-operative societies and village panchayets are now co-operating with the Department of Agriculture in MYSORE State in supplying improved seed, manures, and implements. The members of the Agricultural and Experimental Union, too, are very helpful in supplementing the demonstration work carried out by the department. In TRAVANCORE, special attention was paid to the collection and distribution of seeds of rice and coconut—the two most important crops of the State. The adoption of light iron ploughs for rice cultivation is extending; one local manufacturer alone sold more than 300 in his locality. In the BARODA State the areas under 1027 A.L.F. cotton, a selection of Kolamba rice from Karjat, and Pusa wheats are being extended; nearly 70 tons of cotton seed were distributed in the Navasari District.

CHAPTER VI.

AGRICULTURAL EDUCATION.

I. Agricultural Colleges.

To the provincial agricultural colleges is assigned a dual rôle. They train men for employment in the department and they provide education in scientific agriculture for those who are desirous of turning their instruction to practical account in private farming or estate management. Though ostensibly intended to perform these two functions, a very large percentage of the students who seek admission to these institutions do so with the deliberate intention of obtaining appointments in the department. Of the six colleges now working at Poona, Coimbatore, Lyallpur, Nagpur, Cawnpore and Mandalay, the first four are affiliated to universities. The examination at Cawnpore at the conclusion of the first two years has been recognized by the Intermediate Education Board, and proposals have been mooted for the rearrangement of the second part of the diploma course which, if accepted, will change it in all but name into a university course for a degree in agriculture. The affiliation of the college at Mandalay to the local university will be effected as soon as it is found practicable to raise the standard of admission. In addition to these full grade colleges of the Agricultural Department, there is also the Allahabad Agricultural Institute run and financed by the American Presbyterian Mission at which two courses of intermediate college standard are given: one in agriculture and the other in dairying. Since the closing of the college at Sabour, the three eastern provinces of Bengal, Bihar and Orissa and Assam have been without an institution for higher education in agriculture, for the scheme of an agricultural institute at Dacca has not yet materialized. The Agricultural Research Institute at Pusa and the Imperial Institute of Animal Husbandry and Dairying at Bangalore provide post-graduate courses qualifying for the highest appointments in the agricultural services.

THE AGRICULTURAL COLLEGE AT POONA had this year on its rolls 220 students, including 77 fresh-men. As the number of

suitable applicants from the Bombay Presidency itself desiring training has increased, the admission of candidates from other provinces has been limited to about 10 per cent. of the total vacancies in the first year class. The results of the university examinations for the year were on the whole satisfactory; 46 candidates sat the examination for the degree of B.Ag., and 27 passed.

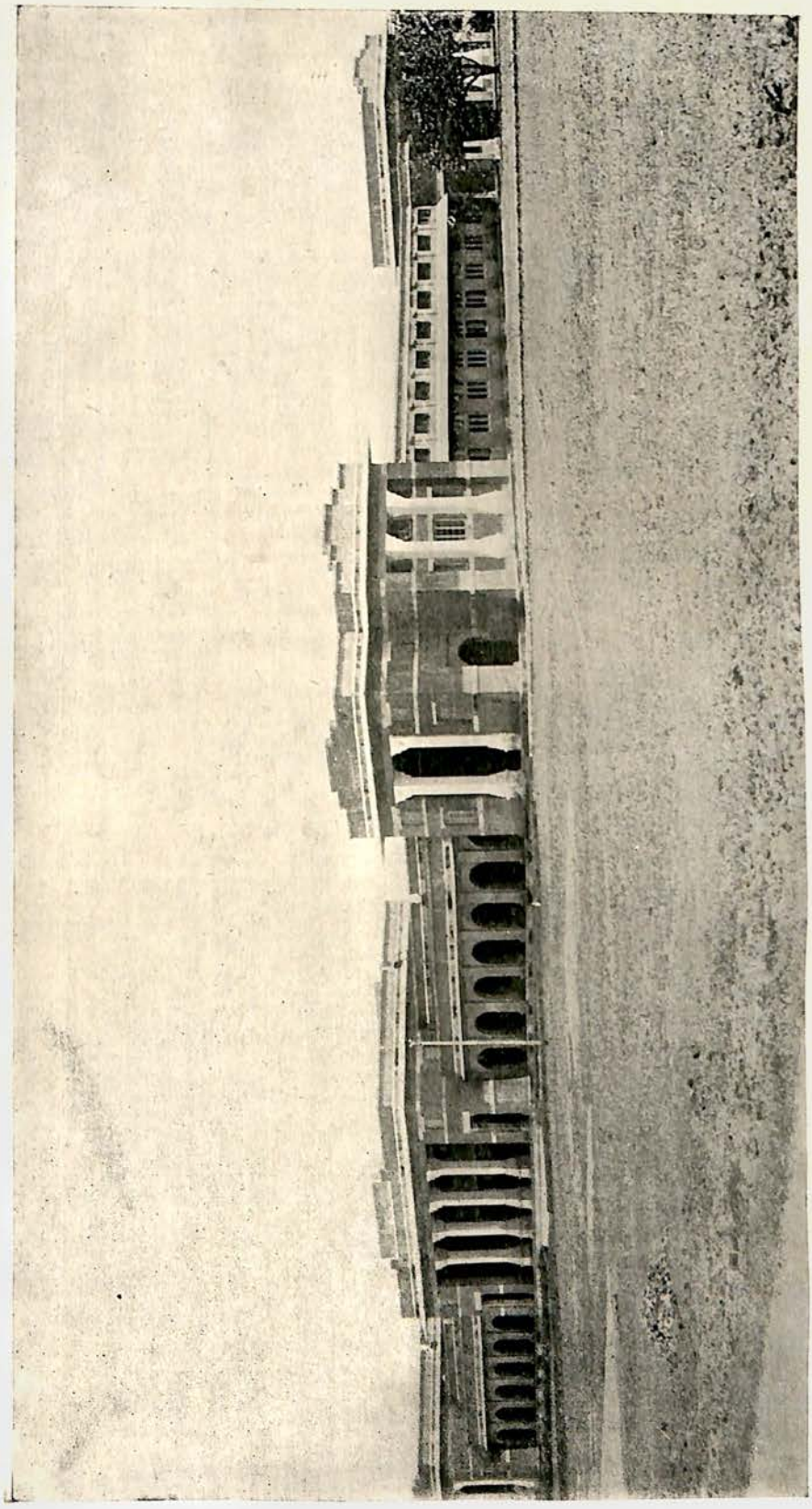
With the opening of the new Freeman Building, the AGRICULTURAL COLLEGE AT COIMBATORE can now admit 40 students each year. This number was selected from 173 candidates who presented themselves for interview; two years ago the number of applicants for admission was only 49. At the degree examination held during the year, all the seven who appeared passed.

The 4-year degree course of the PUNJAB AGRICULTURAL COLLEGE at Lyallpur attracted a record number of applicants but accommodation can be found for 83 only. In all, 30 students and ex-students qualified for the degree of B.Sc., the percentage of passes being 70 as against 55·3 in the previous year. In the examination for the College Leaving Certificate, 20 passed out of 23. An area of land has been earmarked at Shergarh with a view to providing facilities whereby graduates can acquire practical experience of farming but no further progress with this scheme took place during the year. Proposals for raising the standard of admission to the degree course of the college from the Matriculation to the First Examination in Science are under consideration.

The 148 students on its rolls during the year under report constituted a record for the AGRICULTURAL COLLEGE AT CAWNPORE. Of these, 92 were taking the four-year diploma course and 56 two-year certificate course. In the annual examinations 9 students obtained the diploma, while the certificate was awarded to 27.

Since the affiliation of the AGRICULTURAL COLLEGE AT NAGPUR to the local university, the number of applications for admission to the degree course has steadily increased; there were this year 173 candidates for 47 seats. The examination results were, on the whole, satisfactory, there being only 27 failures out of the total number of 109 examined.

All the 11 students who appeared at the first diploma examination of the AGRICULTURAL COLLEGE AT MANDALAY passed. Though every selected entrant to the college gets a scholarship, there were



THE FREEMAN BUILDING, COIMBATORE.

only 35 candidates for admission, of whom 18 actually formed the first-year class.

The two-year post-graduate course at the AGRICULTURAL RESEARCH INSTITUTE, PUSA, was completed during the year under report by Messrs. G. I. Kavoor, B.Sc., and S. N. Nunjudiah, B.Ag. in Mycology, and Messrs. A. T. Sen, M.Sc., and R. P. S. Chauhan, L.Ag., in Chemistry and Botany, respectively. Mr. Kavoor, while under training, received the appointment of Agricultural Officer in the Andamans. None of the 34 candidates for admission to the new session beginning on 1st November, 1926, was considered by the Selection Committee qualified for post-graduate training. A scholar of the Punjab Government was, however, subsequently admitted to the course in Botany. Together with five admitted in the previous year (two for Botany and one each for Agricultural Bacteriology, Mycology and Chemistry), there were thus six students under training at the close of the year. The one post-graduate student of the Imperial Institute of Animal Husbandry and Dairying was given short courses at Pusa in estate management, cattle-breeding, plant-breeding, plant diseases, etc., during the last three months of his period of training.

The 15-month post-graduate course in animal husbandry and dairying started at the IMPERIAL INSTITUTE OF ANIMAL HUSBANDRY AND DAIRYING, BANGALORE, on 2nd January, 1926, was completed by one student during the year under report. There were eight applicants for admission during the fourth session, of whom five were selected. Mr. Gandhi during his stay in Bangalore paid many visits to the Bangalore Institute, to study the methods of breeding and feeding practised thereon.

Fourteen students appeared for the Indian Dairy Diploma examination and nine were declared successful. Of the six fresh candidates, five were from the Allahabad Agricultural Institute and one from Bangalore, while out of the eight students permitted to appear on a second occasion after a repeat course of six months, five came from Allahabad and three from Bangalore.

II. Agricultural Schools.

Since 1917, the department has been experimenting with various types of agricultural middle schools which aim at giving a vocational

training which will fit the sons of the tenant and small zemindar for their station in life. These schools have not as yet appealed to the people for whom they are intended. Even in Bombay the reported success of whose first venture in this direction encouraged the Board of Agriculture to recommend their example to other provinces, two of the schools opened had to be closed. In Madras, the Central Provinces and Bengal which were the first to follow in the wake of Bombay, the results have been even more disappointing. It is not desirable to increase the number of such vocational schools; they are very expensive and the demand for vocational training in agriculture for boys is very small. When other provinces were busy experimenting with vocational schools, the Punjab took its own line and stood out for giving a practical bent to education in rural areas by including agriculture in the curriculum of the ordinary vernacular middle schools. The special features of this scheme are that a small farm or plot is attached to the school and that an elementary training in the practice and principles of agriculture is given in the four higher classes by a teacher specially selected for the work and trained for a year at the Agricultural College at Lyallpur. The aim in view is to give the boys a "bias" towards agriculture as a vocation; to stimulate their interest in the land, and to equip them to be better farmers. This form of rural education, which is now finding favour in other provinces, too, aims in short at adapting rural education to rural needs. This can be done on a large scale and at a small cost by utilizing existing schools.

The six agricultural vocational schools in the BOMBAY PRESIDENCY provide a vernacular course of 2 years in practical agriculture. Since their intended object has not, for want of numbers, been fulfilled, they are now serving a useful purpose in so far as teachers to be employed in primary schools of type similar to the Punjab "bias" schools are trained there. The 181 students on the rolls were not sufficient to justify their continuation as purely vocational schools. These "bias" schools are becoming popular: their number will be extended as fast as teachers trained to the work can be turned out.

Of the two agricultural schools in the MADRAS PRESIDENCY, the one at Taliparamba at last looks like becoming popular; there

were this year 76 applications for 40 seats available. The other school at Anakapalli has failed to attract students and may have to be closed soon. The Government, however, do not propose to stop further experiments in this type of education, and two more schools are to be established at Kalhasti in the Chittoor District, and at Usilampatti in the Madura District. The classes for juvenile and adult labourers at the agricultural stations at Coimbatore, Palur and Anakapalli in Madras continued to work satisfactorily. Though the cost of these is no doubt high, they provide a number of Kamdars for employment on demonstration work.

The paucity of students at the one agricultural school in BENGAL, namely, that at Dacca, shows that there is no demand for this type of education in the province. In spite of considerable advertisement, there were only six students in the first-year class and four in the second-year, whereas there is accommodation for a total of 30. The school is therefore largely utilized for a refresher course for members of the subordinate agricultural service. The scheme for introducing agriculture in the curriculum of ordinary schools of the Education Department has progressed to the extent that the training of teachers for 15 schools selected for the purpose will begin early next year. The agricultural classes introduced in eight middle and high English schools through non-official initiative are reported to be doing well.

There were 65 students taking the ordinary two-year course at the Bulandshahr vocational school in the UNITED PROVINCES. There are in the province two more vocational schools at Allahabad and Ghaziabad maintained by non-official bodies and receiving Government aid. The Bulandshahr school caters mainly for the needs of the western districts, and sanction has been accorded for establishing similar schools for the eastern districts and Oudh at Gorakhpur and Fyzabad, respectively. Like the Bulandshahr school, these new schools will also be utilized for training the teachers required for agricultural "bias" schools of the Punjab type. For the teachers already available 20 school farms have either been established or are in course of establishment, and 14 more centres have been selected for the location of those under training at present.

In the PUNJAB, in which the first real effort was made to adapt rural education to rural needs, the number of " bias " schools rose from 80 to 102. Each school has either a garden or farm attached to it for practical work; some of the farms are not only self-supporting but show an annual balance to their credit.

The conversion of the Powarkhera school in the CENTRAL PROVINCES from a purely vocational school into an ordinary anglo-vernacular middle school with agriculture as one of the subjects of instruction, has been the means of attracting a larger number of students. The 53 students on the rolls at the end of the year showed an increase of 50 per cent. over the figure for the previous year. Boys intending to take a definitely vocational course will in future be drafted to the newly started Buldana farm on which a Peace Memorial Hostel will be maintained to accommodate them.

The first batch of 18 students completed, during the year, the full 4-year course of the subsidized agricultural school at Pyinmana in BURMA, which is managed by the American Baptist Mission. This school, like the one at Powarkhera in the Central Provinces, gives training in agriculture along with an ordinary middle English school course.

The Hebbal and Chikkanhalli schools in MYSORE had 37 and 15 students, respectively. Of the 16 students in the final class at Hebbal, 11 were considered good enough for the diploma and the rest were awarded only certificates. At the other school, all the fifteen were declared successful in the annual examination. Two more vocational schools of the type at Chikkanhalli have been sanctioned for location at Nagenhalli and Ramakrishnapur.

Fourteen students are under training at the Alwaye school in TRAVANCORE. Of the two batches of students trained in previous years, 17 have come into the new colonisation scheme started by the department. Each of them has been given 10 acres of land at concessional rates and a small loan to start cultivation.

III. Short courses.

Short courses in cattle-breeding and dairying were provided at BANGALORE for seven students from different provinces. The

Dairy Diploma students from the Allahabad Agricultural Institute also received technical instruction at the Bangalore and Karnal farms and at the Anand creamery. At PUSA, two students took a short course in entomology, one in mycology and one in lac-culture.

There is such an insistent demand for the six-month practical vernacular course at LYALLPUR that it has been found necessary both to duplicate it, and to start similar classes on the experimental farms at Gurdaspur and Hansi. The rural economy class, which lasts for a month, was attended by 15 officers of other departments, while 32 senior vernacular teachers qualified themselves for the teaching of agriculture in rural middle schools. With a view to training village blacksmiths to repair oil-engines and modern implements, a two-month course is being given at the agricultural workshop in Lyallpur. Ten sub-inspectors of the Co-operative Department attended a special one-month course in dairying specifically instituted for them.

A general course in agriculture lasting for one month was arranged at the CAWNPORE Agricultural College for 19 inspectors of the Provincial Co-operative Department. Three students took special short courses in sugarcane cultivation at Shahjahanpur, and at the suggestion of the Chairman of the Agra District Board, 35 primary school teachers were given a fortnight's course in practical agriculture on the Bichpuri farm. The engine-drivers' class at the Bulandshahr school was attended by 10 students.

A class for engine and tractor drivers on the NAGPUR farm in the Central Provinces was attended by 15 students. Eleven of these were given a certificate of competency on the completion of the course. In response to what appeared to be a local demand, a seven-month course in practical agriculture has been started for the sons of *bonâ fide* cultivators on the Yeotmal farm in BERAR. The four students admitted during the year received stipends from the local District Council.

As an experimental measure, cultivators' sons are being admitted to Government farms in BENGAL, who, while receiving wages for ordinary farm work, are given training in improved methods of agriculture.

In BURMA, short courses extending for the minimum period of a week were given to 105 adult farmers at the principal central

farms. At Hmawbi and Mahlaing, a practical course of nine months has been started with 10 students in each case.

Nineteen apprentice demonstrators, including eight selected during the year, were under training on different farms in ASSAM.

CHAPTER VII.

THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE.

The rural problem to which co-operation has been mainly applied in India has been that of rural indebtedness. With the numerical increase of credit societies, a knowledge of the principles underlying co-operative work has gradually spread among the people, and in areas where these have been best understood, societies are to some extent supplementing the work of Agricultural Departments in distributing improved seed, fertilizers and implements. Societies specially devoted to productive and distributive business have in the majority of cases proved failures in the absence of business-like, honest management. The good work done by the Cotton Sale Societies in Bombay, the Irrigation and Milk Societies in Bengal, the Co-operative Seed Societies and Dairy Society in the Central Provinces and the Societies for the Consolidation of Holdings, Clearance of Silt in Canals and Sale of Farm Produce in the Punjab encourages one to hope that, given the necessary organizing staff, co-operation will play in course of time as great a part in assuring the cultivator of the full return of his labour as it has in providing him with cheap capital.

Bombay. The number of agricultural credit societies rose from 3,615 to 4,022, the membership from 239,134 to 260,182, and the working capital from Rs. 2,93,05,953 to Rs. 3,45,97,255. With an increase of 11, as against 30 in the previous year, the number of non-credit agricultural societies stood at 264. In the words of the Provincial Registrar, " scarcely one in three of the total number of (non-credit) societies are proper working institutions." The most important of these are the 53 sale societies which earned a profit of Rs. 66,263 on sales of Rs. 72,55,159. The most successful form of sale business continued to be that done by the Provincial Bank through its branches and special shops. Of the sales of over 8 lakhs of rupees, over 25 per cent. was represented by manures. Societies for the purchase and supply of manures, seed and

implements are stated to be mostly in a state of stagnation, while only 3 of the 18 cattle-breeding societies on paper are described as worthy of the name. Some of the irrigation societies are doing good work, but power pumping societies have proved a failure, and all except one have been cancelled. Among the land improvement societies, the most successful are the Yelvigi Waddars' Society in Dharwar and some fencing societies in Kanara.

Madras. The number of agricultural credit societies rose from 9,822 to 11,000, the membership from 523,564 to 583,315 and the working capital from Rs. 3,98,23,367 to Rs. 4,89,51,740. Of the 10 land mortgage banks in the Presidency, only two did appreciable business during the year. The number of societies devoted to purchase and sale increased from 98 to 116, but there was a decline in their trading activities. On a working capital of Rs. 6,65,296, they suffered a loss of Rs. 48,025. Among the 16 societies for production and sale, one contributed the entire loss of Rs. 17,051. The 300 societies representing other forms of agricultural co-operation have among them 13 for agricultural demonstration, 9 for land reclamation and 12 for irrigation.

Bengal. The number of agricultural credit societies rose from 11,169 to 13,398, the membership from 280,503 to 329,765, and the working capital from Rs. 2,56,53,753 to Rs. 3,20,83,931. Satisfactory progress has been made, too, in the development of other forms of co-operation. Societies for purchase and sale now number 78, as against 22 three years ago, while irrigation societies have increased from 173 to 377 in the same period. Societies for the sale of jute, though faced with competition from powerful vested interests, have made a promising beginning. Since the close of the year they have been strengthened by being federated into a central society at Calcutta. Of the irrigation societies, 194 are in Birbhum and 165 in Bankura. Of the 30 co-operative agricultural associations started to run model farms on commercial principles, those at Chaudanga and Naogaon have played a useful part in supplying their members with improved seed and agricultural implements. Generally speaking, such associations have a chance of success only in areas where the Agricultural Department has done pioneer work in creating a demand for pure seed, improved implements and new manures.

Bihar and Orissa. The number of agricultural societies rose from 6,608 to 7,614, the membership from 177,136 to 205,825, and the working capital from Rs. 1,62,64,536 to Rs. 1,99,88,238. The 9 societies for purchase and sale and 14 societies for production and sale are all more or less in an unsatisfactory condition, and will have to be closed down gradually. Some of the central banks, aided by a subsidy from Government, have, however, started godowns for the supply of improved seeds and manures with good results. The number of grain *golas* (stores) has been increased from 84 to 91 ; they made a profit during the year of Rs. 21,231 on a working capital of Rs. 3,16,858. The *golas* are particularly useful in tracts where transactions in grains are in vogue ; they, provide, too, a reserve stock of grain for use during years of scarcity.

United Provinces. The report of the Oakden Committee having brought in the fore-front the necessity for re-organization, the number of agricultural credit societies was reduced by 20 to 5,874. The membership, however, rose from 144,225 to 145,981, and the working capital from Rs. 88,23,835 to Rs. 92,78,900. Of the six non-credit agricultural societies on paper, three are dairies and three have as their object the consolidation of holdings : no real consolidation has so far been effected by the latter.

Punjab. The number of agricultural societies increased from 12,167 to 14,148, the membership from 344,731 to 402,585 and the working capital from Rs. 4,38,85,128 to Rs. 5,35,66,327. The ten mortgage banks at work during the year advanced 133 loans for the redemption of 5,530 acres, and 31 for the improvement of land. Societies for consolidating holdings now number 314. The 81 new societies registered during the year covered an area of 38,071 acres, in which 45,165 blocks were, by redistribution, reduced to 8,861 and the average size of a block increased from 0·85 to 4·3 acres. The total number of new wells sunk and old wells repaired in the land consolidated up to date is estimated to be 500. The societies for silt clearance have increased from 23 to 26, and continue to do valuable work. At the close of the year there were 176 societies for cattle-breeding as against 43 two years ago. They have 3,771 members who maintain 4,229 registered cows. The District Cattle-breeding Associations in Gurgaon and Rawalpindi are reported to have done nothing useful. Only three out of five sheep-breeding

societies are active. Of the 23 milk-recording societies, seven in Montgomery, where the members are bound by the cattle-breeding conditions of their land grants, are operating regularly. The number of better farming societies increased from 55 to 99. The members have agreed to cultivate their lands on improved lines as laid down by the Agricultural Department, but by no means the whole of the controlled area of 42,000 acres is at present cultivated as required. There are also five societies for reclamation of land, and the same number of land holding societies. With an increase of 5 in the year, the number of commission shops rose to 18 ; they sold produce worth Rs. 27½ lakhs. Of the remaining 12 rural supply unions, only three are doing good work ; the other nine are to be closed. The twelve rural supply societies are all prospering.

Central Provinces. Increased caution in the registration of new societies and more prompt liquidation of unsatisfactory ones combined to further reduce the number of agricultural credit societies from 4,071 to 3,966. The membership of 58,039 and the working capital of Rs. 1,58,71,045, however, showed an increase of 506 and nearly 10 lakhs of rupees, respectively. The number of credit societies doing seed business in the Sihora tehsil declined from 66 to 57 and that of agricultural unions organized for the production and distribution of cotton seed from 9 to 4. The relieving feature in the picture is the success of agricultural associations for the sale and hire of implements of which there are now 11. Their turn-over increased during the year by 100 per cent., and their profits by 175 per cent. The satisfactory working of the Akola commission shop has encouraged the starting of similar institutions at Amraoti and Dhamangaon. The first of the two last named has made a good start.

Burma. Unsatisfactory societies are gradually being weeded out, with the result that the number of agricultural credit societies declined during the year from 4,032 to 3,901, and their membership from 91,369 to 87,447 ; but the working capital of Rs. 2,29,08,733 exceeded that of the previous year by over 11 lakhs of rupees. Non-credit agricultural societies have similarly been reduced from 89 to 73. A large majority of the latter are working at a loss ; the six societies for production (irrigation and embankment) exist only on paper.

Assam. The number of agricultural credit societies rose from 883 to 998, the membership from 36,927 to 42,478, and the working capital from Rs. 15,30,443 to Rs. 18,31,145. The Kamrup Co-operative Land Mortgage Bank made an excellent start during the year ; another bank has since been started in Sylhet. There are no non-credit agricultural societies in this province.

Delhi. With a net increase of five during the year, there are now 204 agricultural credit societies ; the membership similarly rose from 3,813 to 4,250, and the working capital from Rs. 4,80,503 to Rs. 5,82,764.

North-West Frontier Province. There are only 27 agricultural credit societies in this province with a membership of 681 and a working capital of Rs. 50,099.

Co-operative Cotton Sale Societies.

There are 31 cotton sale societies in the Bombay Presidency, which sold during the year under report cotton of the value of Rs. 40½ lakhs, as against Rs. 62½ lakhs in the previous year. The decrease was mainly due to a smaller crop and to poor prices. Though the Hubli society continues to do excellent work, societies of the Karnatik type are beginning to suffer from the results of their over-ambitious policy. The admission of cotton dealers as members and the sale of cotton of non-members have proved disturbing factors, and it is proposed to reorganize the whole sale movement in the Southern Division on a policy of (*a*) membership based on societies or members of co-operative societies, (*b*) no admission of persons dealing in the same commodities as the society sells, and (*c*) sale of members' produce only. The 16 cotton sale societies of Gujarat, which sold cotton worth Rs. 13½ lakhs, are distinguished from the Karnatik type in that they sell only members' cotton, and no one is admitted as a member who does not use the improved seed distributed by the societies. Owing to the cohesion, loyalty and unity of purpose amongst their members, the Gujarat type has proved much more co-operative in the true sense. The five cotton sale societies in the Baroda State handled cotton worth over two lakhs of rupees. Four more societies have been registered for work during the coming season.

Co-operative Milk Societies.

Of the six dairy societies in the Bombay Presidency, the one at Malwan is a genuine rural body, the *gaoli* members of which are substantial, and in some cases educated, cattle-owners. The number of milk societies in Bengal increased from 76 to 97 ; 82 of these are affiliated to the Co-operative Milk Union in Calcutta. The latter earned a profit of Rs. 12,148 on sales of Rs. 1,54,122. On a share capital of Rs. 10,069, these affiliated societies have built up a reserve fund of Rs. 35,844. A beginning has been made this year for the supply of milk to the town of Madras by organizing a dozen milk supply societies in the Chingleput District. The financial position of the *gaoli* society at Telinkheri in the Central Provinces which supplies fresh milk to the Nagpur City continues to be satisfactory ; on the other hand, the Amraoti dairy society is in a bad state. Of the three dairies in the United Provinces, two at Benares and Lucknow have been in a moribund condition for a long time ; the third at Allahabad continues to exist in a sort of way. The dairy society at Mayaganj in Bihar and Orissa is running at a profit.

Cattle Insurance.

This form of co-operation has not been found to prosper in India. Only one of the eight societies on paper in Bombay was able to collect premia, while the four societies registered more recently in Madras have hardly done any business worth the name. In Burma, which initiated the experiment, cattle insurance societies are reported to be gradually deteriorating ; the number of societies dwindled from 395 to 390, the amount of risk insured from Rs. 36,125 to Rs. 19,140 and the premia collected from Rs. 1,438 to Rs. 612.

CHAPTER VIII.

LIVE STOCK.

I. Prevention and Treatment of Disease.

The ravages of rinderpest having abated to some extent in the Bombay Presidency, the Punjab, the Central Provinces and Bihar and Orissa, the total reported mortality from contagious diseases dropped from 399,845 in 1925-26 to 322,331 for the year under review. Of the latter figure, as many as 203,717 deaths were from rinderpest. The provinces which suffered most were Burma, Bengal and Assam, each of which lost through rinderpest over 30,000 bovines, while the Punjab, Madras and the United Provinces each recorded more than 20,000 deaths from this fell disease. The number of preventive inoculations performed, amounted to 1,527,213, as against 1,550,199 in the previous year. As inoculation is purely voluntary except in notified areas in the Madras Presidency, these figures indicate that the confidence of the Indian peasant in the Veterinary Department is growing.

The number of hospitals and dispensaries maintained for the treatment of disease rose from 720 to 786, and the cases treated therein from 1,742,048 to 1,904,478. In addition, 1,226,256 cases were treated by itinerant veterinary officers. The total number of 3,130,734 cases treated, as against 2,839,688 in the previous year, is another indication of the fact that old prejudices are dying out and that the beneficent work of the Veterinary Department is appreciated by cattle-owners.

In addition to the saving of cattle life from the ravages of disease, the Veterinary Department performs on a fairly large scale in some provinces the important function of emasculating inferior and undesirable bulls and of thereby rendering them incapable of propagating their kind. The department is thus preparing the field so to speak for the distribution of selected stud bulls. During the year under review, 343,443 scrub bulls were castrated, as against 195,427 in 1924-25. This increase of 75 per cent. in two years would be quite satisfactory were it not for the fact that it has been contri-

buted mainly by one province. In other provinces some aversion to the operation still persists. It is significant that the number of bulls offered for emasculation is particularly small in provinces where the worst types of cattle are to be found.

II. Incidence of Disease.

Bombay. The outbreaks of rinderpest were comparatively few; the 11,613 deaths from contagious diseases of different kinds were less than half of those in 1925-26. Foot-and-mouth disease was, on the other hand, very prevalent.

Madras. The total loss of 46,371 animals from contagious diseases was practically the same as in the previous year. Rinderpest continued to rage with virulence; black quarter, too, caused many deaths. There was, however, a marked decrease in the incidence of other diseases.

Bengal. Rinderpest prevailed more or less throughout the province and accounted for 93 per cent. of the total loss of 35,719 head of cattle—the highest figure for the last quinquennium.

Bihar and Orissa. The total reported deaths from contagious diseases were only 9,318 or 56 per cent. of that in the previous year and the lowest in the last quinquennium.

United Provinces. There was no substantial reduction in the number of deaths from rinderpest, but other contagious diseases were less rife than in the previous year: the total mortality dropped to 30,789, as against 40,738 in the previous year.

Punjab. With a decrease in the incidence of rinderpest, the mortality from contagious diseases dropped from 71,835 to 45,396. Surra was less prevalent among equines, but 1,380 bovines succumbed to this disease as against nil in the previous year.

Burma. Rinderpest accounted for 90 per cent. of the 44,041 deaths from different bovine diseases. The principal reduction was in the North Shan States where only 4,488 cattle succumbed to rinderpest, as against 12,865 in 1925-26.

Central Provinces. The mortality from rinderpest dropped by more than 75 per cent; the number of deaths from contagious diseases of all kinds was only 20,331, as against 46,265 last year.

Assam. In the mortality from rinderpest, Assam stood third:

the total number of deaths reported from contagious diseases was 52,956.

North-West Frontier Province. Of the total mortality of 3,636, almost half was from rinderpest. Surra was mostly prevalent in the Malakand Agency and accounted for 27 deaths.

Sind. With an increase in the incidence of rinderpest, the total mortality rose from 2,943 to 4,197.

Baluchistan. The total number of deaths reported was 4,996, as against 5,706 in the previous year. Anthrax and foot-and-mouth disease accounted for most of the deaths.

Rajputana. The mortality from contagious diseases dropped from 718 to 27, mainly owing to the suppression of rinderpest.

III. Preventive Inoculation.

Rinderpest having continued to levy its heavy toll, last year's record demand for the products of the Imperial Institute of Veterinary Research at Muktesar was exceeded and 63,18,758 doses of different sera and vaccines were issued. The following table compares the doses issued during the year under review with the averages for the previous five years :—

	1926-27	Average of previous 5 years
Rinderpest serum	53,80,187	29,99,698
Anthrax serum	29,047	41,017
Hæmorrhagic septicæmia serum	3,63,709	2,61,521
Do. do. vaccine	2,88,350	1,97,900
Blackquarter vaccines	1,30,100	47,515
Mallein	40,078	48.711

After meeting this heavy demand over 48 lakhs of doses remained in stock at the close of the year. The capacity of the Institute to supply products for combating animal diseases has been much increased by developing the resources of the sub-station at Izatnagar where all the required anti-rinderpest serum is now manufactured. It is anticipated that there will always be three-yearly periods of

depression alternated with similar periods of recrudescence of rinderpest in India so long as permanent immunity is not conferred on all bovines, but the last two years' experience gives one reason to hope that when the next period of recrudescence arrives, Muktesar will be in a position to meet in full the consequent demand for serum.

Preventive inoculation against rinderpest is still being carried out mainly by what is known as the serum-alone method. It has been accepted as the most suitable for India on account of its simplicity and absolute safety. The only claim made for it is that it carries an animal exposed to infection through an outbreak; that it does so will be manifest from the fact that while the normal mortality from this scourge is up to 75 per cent., the actual deaths from amongst 922,981 bovines inoculated by this method amounted last year to 0·49 per cent. A more lasting immunity can be conferred on animals that have been inoculated with serum alone by allowing them to mix immediately with others that are infected, and to contract a mild infection. As this is difficult to attain, an artificial method has been devised by which cattle are inoculated simultaneously with an adequate dose of serum and a very small quantity of blood withdrawn from an animal at the height of the disease, with the result that the attack, though barely noticeable, makes the animal immune for years. Thus the serum simultaneous method of inoculation has not been attempted on a large scale in India. One objection to this method is that distressing complications are sometimes caused by the unwitting introduction of virulent piroplasms with the rinderpest blood that has to be injected simultaneously with the serum. It is, however, satisfactory to record that in the Mysore State, where the serum-alone method has been abandoned in favour of the simultaneous method, the death rate among 24,555 animals inoculated during the year did not rise appreciably.

The second most important disease in India is hæmorrhagic septicæmia. It is prevalent particularly during the monsoon. The potent serum issued from Muktesar, which confers a short-lived immunity, gave protection during the year to 99 per cent. of the 265,385 animals inoculated. A more lasting immunity can be set up by vaccinating beforehand animals in low-lying villages

liable to visitations of this disease. Of the 204,271 thus protected in the Punjab during the year, only four were reported to have died.

In a severe outbreak of blackquarter on the Hissar farm, the only herds which altogether escaped infection were those which had been inoculated a month before with aggressin. The " aggressin " method of inoculation against blackquarter would appear to be more effective than the old " pillule " method of vaccination.

IV. Veterinary Education.

For the training of students in veterinary science, there are colleges at Bombay, Madras, Calcutta and Lahore and schools at Insein and Taunggyi in Burma. The school at Insein will from next year be raised to the status of a college. The veterinary college which is to be constructed at Patna in Bihar and Orissa will begin to admit students in 1929. This college will have a cattle-breeding and dairy farm attached to it, on which the students will get practical instruction in animal husbandry and dairying. The colleges at Bombay, Madras and Calcutta give a 3-year diploma course in English, while that at Lahore provides a 4-year course. It is proposed to raise the standard of admission to the latter course from Matriculation to the First Examination in Science. The colleges at Madras and Lahore also conduct post-diploma classes for selected subordinate officers of the department. The number of students who passed the diploma examinations of the colleges was 59, as against 50 in the previous year. The supply of trained veterinary assistants turned out by the colleges at present falls short of requirements in some provinces. Proposals are under consideration in Madras to raise the number of stipends, and in the Punjab to start a two-year vernacular course which will equip a man for field work in rural areas. The veterinary schools at Insein and Taunggyi in Burma continued to impart instruction in the vernacular in a 3-year and 1½-year course, respectively. Thirteen passed the final examination at Insein; while five, as against 2 in the preceding year, passed out of the Taunggyi school. In future, only students who have studied up to the High School Final will be admitted to the Insein school. The main college building at Insein has been completed, but the necessary hostel accommodation has not yet been provided.

At the Imperial Institute of Veterinary Research, Muktesar, two officers and one subordinate of the Army Veterinary Corps and one subordinate of the Civil Veterinary Department, United Provinces, took short courses in laboratory methods. Two subordinate officers of the Mysore Veterinary Department are taking a special course of three years at Muktesar. Seventeen farriers were trained at Lahore. At Calcutta two courses of lectures and demonstrations on infectious diseases of animals were given to students undergoing training as sanitary inspectors and three riflemen from Assam Rifles were trained as dressers. Three students passed out during the year from the veterinary compounders' class attached to the Nagpur hospital.

V. Veterinary Research.

At the Imperial Institute of Veterinary Research, Muktesar, all the more important diseases of bovines and equines are being investigated. Some of the results obtained are mentioned below.

Rinderpest. Experiments designed to test the period of immunity conferred by the serum-simultaneous inoculation against rinderpest have revealed that it lasts in a solid form for two years only, after which it commences gradually to wane. The period for which immunity is given by this method of inoculation would appear to depend on several factors, such as the age of the inoculated animal, the degree of reaction, the initial susceptibility of the animal. The success attained during the year in the fixation of rinderpest virus in the goat promises to enable the Institute to issue for the serum-simultaneous inoculation virus free from the parasites of virulent red-water.

Field observations have shown that the ubiquitous piroplasmosis of cattle in India caused by *Theileria mutans* is sometimes responsible for acute sporadic disease in recently imported cattle. Canine piroplasmosis caused by *P. gibsoni* has not proved amenable to treatment with trypanblue, but yields, at least temporarily, to repeated injections of tryparsamide.

Surra. As the result of investigations carried on over a period of years, a satisfactory treatment has been evolved for animals suffering from surra. It consists in the administration simultaneously, intravenously and intrathecally, of a non-metallic organic

compound of complex chemical constitution known as " Bayer 205 ".

Strangles. The so-called " pyo-vaccination " has proved entirely unsatisfactory in dealing with strangles. Serum treatment, based on the assumption that the disease is caused by a so-called ultra-visible virus, is being continued.

Serum preservation. Different methods of preserving the large quantities of serum prepared for issue to the field are being studied. The phenols and cresols have proved unsatisfactory in practice when used alone, as they do not arrest the development of certain minute germs known as " diptheroids." Combination with certain of the acridine dyes seems to hold forth promise of success.

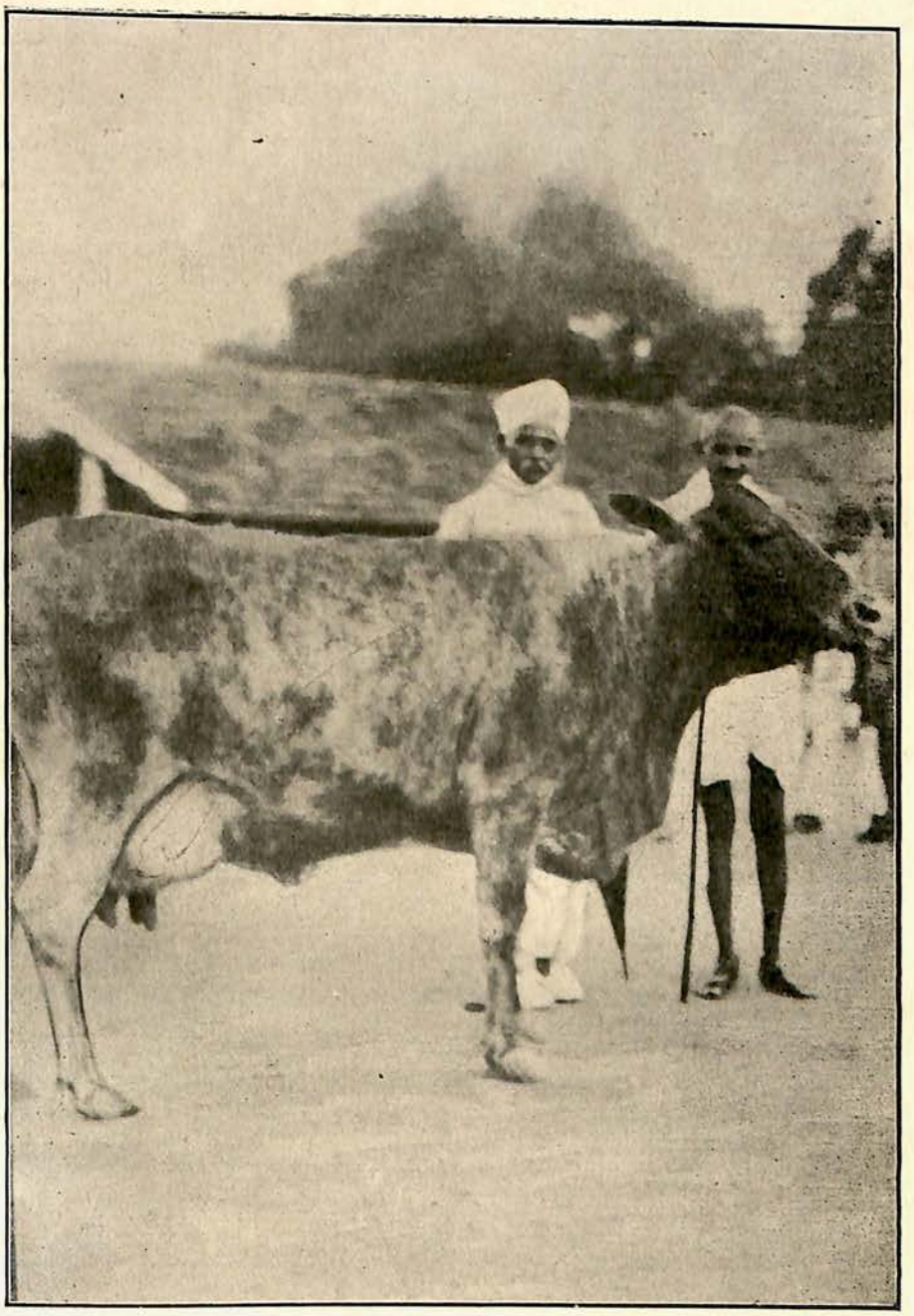
VI. Breeding.

Cattle-breeding. It is reckoned that there are in British India 151 millions of cattle and buffaloes. This works out to 61 per 100 of human population and 67 for every 100 acres of cultivated area. For each 100 acres of net area sown there are approximately 92 acres of uncultivated land available for grazing, so that this total area of 192 acres of cultivated and grazing lands has to support 67 head of cattle in addition to sheep, goats, ponies and other stock. Even with such over-stocking, the draught power available for tillage operations is inadequate, and there is a general shortage of milk and milk products. There are too many scrub half-starved cattle in the country ; what is wanted is an improvement in the efficiency of both males and females. To this end, cattle-breeding farms have been established, pure-bred herds are being evolved by selection, and continuous efforts made to increase the milking capacity of cows of promising sound dual-purpose breeds. In the domain of animal husbandry feeding is as important as breeding, and special attention is therefore being paid to the question of growing and storing fodders. Several very promising fodders have been introduced and methods of storing them in the dry state or as ensilage are being demonstrated. A study is being made of the digestibility and nutritive values of different foodstuffs and fodders at Bangalore and Lyallpur. With the object of demonstrating the possibilities of transporting milk from rural areas where

it is relatively cheap to urban centres where it is dear, schemes have been promoted for supplying milk to the towns of Calcutta, Nagpur, Muzaffarpur, Agra, Hathras, Bareilly and Naini Tal. Dairy managers are being trained at the Imperial Institute of Animal Husbandry and Dairying at Bangalore, and the services of the Imperial Dairy Expert are being fully utilized by Provincial Governments, Indian States, Municipalities and private individuals in connection with their various dairy schemes.

With a view to stimulating and to some extent co-ordinating the efforts being made in the various provinces and Indian States towards cattle improvement, the Government of India have established at Bangalore a Central Bureau for Animal Husbandry and Dairying with the Imperial Dairy Expert as Secretary. Pending the appointment of an expert committee to guide the work of the Bureau, preliminary work for opening herd-books of important breeds has been undertaken. So far 5,000 cattle have been offered for registration as foundation stocks for breed herd-books.

As stated in previous reviews, cattle-breeding operations at PUSA have been directed along two lines: (1) a herd of Sahiwals is being graded up by selective breeding, and (2) the poorer milkers of the same breed are being crossed with Ayrshire bulls of high milking pedigree with the primary object of obtaining reliable information regarding the inheritance of observable characters in the crosses. In the pure Sahiwal herd six cows gave during the year under report over 5,000 lb. each in a lactation period of 304 days, while among the half-bred progeny of rejected Sahiwal cows by Ayrshire bulls the yields of the first six cows ranged from 8,000 to 11,000 lb. In the Montgomery herd the average yield per cow per day was 11·7 lb., while in the latter it was 20·5 lb. To those familiar with the small yields obtained from Indian cattle, the fact that 4,000 lb. in a lactation period of 10 months is now the minimum standard for the retention of any cow in the herd tells its own tale. Compared with yields ranging from 6,000 to 8,000 lb. in a similar period from cross-bred Ayrshire-Montgomery cows the average yield of this fine Montgomery herd looks small. It must be remembered, however, that such cross-bred animals are less hardy and disease-resistant than those of pure indigenous breeds. The average percentage of cows in milk was 48 and 68 for Montgomeries and



MR. GANDHI AND PANDIT MALAVIYA ADMIRING "JILL" OF THE DAIRY HERD OF THE IMPERIAL INSTITUTE OF ANIMAL HUSBANDRY AND DAIRYING, BANGALORE.

Jill has given 16 calves and 140,000 lb. of milk, of which over 12,000 lb. were given in one lactation period of 300 days.

cross-breds respectively. Thus a cross-bred cow not only gives more milk than the best representative of her dam's family but also calves more frequently—an important advantage in commercial dairying. Having produced a cross of good milking capacity by adding Ayrshire blood and having proved that the sire is prepotent as regards milk production, attempts are being made to adapt the cross to the needs of the country by mating half-bred dams with Sahiwal bulls of good milch pedigree. Some of the ¼-Ayrshires thus produced have come into milk, and all that can be said at present is that they promise to justify the policy pursued.

In accordance with the breeding policy adopted at Pusa, most of the cross-bred cows on the BANGALORE and WELLINGTON farms are now sired by Indian bulls of good milch pedigree. There are also herds of Scindi cows on these two farms. At Karnal, pure herds of Thar-Parkar and Hariana cattle and Murra buffaloes are being established. His Excellency the Viceroy visited the Karnal cattle-breeding farm in August and November 1926 and the Imperial Institute of Animal Husbandry and Dairying, Bangalore, in July 1927, and expressed himself as being very pleased with the work in hand. The Creamery at Anand, which has been permanently taken over by the Imperial Department of Agriculture, has been equipped with an experimental milk condensing plant with a view to manufacturing sweetened and unsweetened condensed milk from village buffalo milk. Condensed and preserved milk of the value of over 75 lakhs of rupees was imported into India last year.

Such well-known Indian breeds of cattle as the Hariana, the Dhanni and the Sahiwal are indigenous to the PUNJAB. The first two are essentially draught breeds, while the third is better known as a milch breed. By a process of rigid selection high quality bulls of these breeds are made available to cattle-owners, and there were 2,501 of them at stud during the year. As regards the supply of Hariana bulls, the resources of the only Government cattle farm in the province, namely that at Hissar, are being supplemented by three private farms started on Government land granted for the purpose. Bulls of the Sahiwal and Dhanni breeds are obtained by subsidizing breeding operations on similar lines. Steps are being taken to increase the number of bulls reared at Hissar, and to start two more Government farms—one in the Nili Bar Colony and one in North

Punjab. The scheme for subsidizing the maintenance of approved bulls in the Hariana and Dhanni tracts is working satisfactorily. The three district boards in the former area received grants of Rs. 20,000 conditional on their spending an equal amount, while four in the latter were given Rs. 18,200 on the same terms. In the Gurgaon District alone there are now 521 approved bulls, of which 100 were purchased during the year from the Hissar farm.

The small herd of Awankari cattle established in 1916 at Tarnab in the NORTH-WEST FRONTIER PROVINCE has increased to 50 head. So far the Tarnab cows have not been milked; the primary object kept in view has been to secure pure lines to breed from. Having attained this object, it is now proposed to maintain milk records with a view to studying the milking capacity of this breed. A dairy is in the process of construction, and the herd is to be increased to three times its present number.

In the UNITED PROVINCES, the Department of Agriculture maintains two cattle-breeding farms, one at Madhurikund in the Muttra District and the other at Manjha in Kheri Lakhimpur. The area of the former station was enlarged during the year from 613 acres to 1,396 acres with a view to increasing the herd of Hariana cattle and starting an additional herd of Murra buffaloes. A herd of 65 selected Hariana cows has been kept separate with a view to establishing a milch type of this very promising dual-purpose breed. On the farm at Manjha pure herds of the local Kherigarh and Sahiwal cattle and Murra buffaloes are maintained. The last two types have been imported with a view to improving the milking capacity of the local cattle: they are standing Terai conditions well and are getting rapidly acclimatized. There is a good demand for bulls reared on these two farms; though 228 bulls were available as against 100 in the previous year, all requisitions could not be met. There are now 597 selected bulls at stud in the province as compared with 246 in 1922-23 when cattle-breeding work was transferred to the Agricultural Department. In the two controlled breeding areas started in the districts of Muttra and Etawah, approved Hariana bulls are located in every village. It will be possible to demonstrate in these areas the value of concentration in cattle breeding. The village dairy schemes initiated and subsidized by Government are producing desired results. The success of the Agra

dairy has encouraged several people to supply pure milk to that city.

The only cattle farm in BENGAL is at Rangpur where both local and imported Hansi bulls are used for mating with indigenous cows. The progeny of the Hansi cross are superior both in milk yield and draught qualities to the local breed. There are small herds of Scindi and Thar-Parkar cattle on the Dacca farm.

In BIHAR, herds of milch cows of mixed breeds are maintained at Sabour, Monghyr and Kanke where there is a good demand for milk. The cows on these farms are mated with bulls of the Sahiwal breed. The Sepaya farm is being utilized for buffalo breeding and as a depôt for young stock from Monghyr. On the cattle-breeding and dairy farm at Patna cows of the local breed are being crossed with Thar-Parkar bulls.

The scheme for the establishment of a cattle farm at Khanpara in ASSAM is well under way; some of the necessary buildings have been erected, and an initial herd of 2 bulls and 15 cows has been purchased from Bihar. The primary object of this farm will be the improvement of draught bullocks required for work on the plains.

Stock-breeding on scientific lines has not hitherto received any attention in BURMA, but a beginning has been made by the selection of land for cattle-breeding at Tatkôn and Kanabalu. The small herd of Scindi cattle established at the Mandalay college for instructional purposes is doing well.

There are nine cattle-breeding and two dairy farms in the CENTRAL PROVINCES. At Garhi, Powarkhera and Telinkheri, pure herds of Gaolao, Malvi and Montgomery cattle are maintained. The first two are draught breeds, while the Montgomery is essentially a dairy breed for urban areas. The Gaolao is the only local breed showing any distinctiveness of type. An attempt is being made to grade up the non-descript animals commonly found in this province by using Montgomery and Malvi bulls as sires. At the dairy farm attached to the Agricultural College, Ayrshire-Hansi cows are being crossed with Montgomery bulls. Of the 308 animals reared for sale on these farms, 63 were bulls. The 20 pure Gaolao bulls sold from the Garhi farm fetched an average price of Rs. 292 per head—an increase of Rs. 33 over the figure for the previous year. Under the scheme for subsidizing cattle-owners who are willing to

maintain stud bulls for the public good, 55 premia were granted during the year. A comprehensive scheme has been prepared for extending breeding operations. The scheme provides for the establishment of pure bred herds at five centres, the conversion of seven cattle farms into depôts for young stock, and the opening out of forest areas in the Melghat and Mandla for grade breeding. When the whole scheme is fully developed, it is calculated that about 600 bulls and 800 bullocks will be available each year.

The breeds under improvement in BOMBAY are the Kankrej at Chharodi and Surat, the Amrit Mahal at Bankapur, the Scindi and Thar-Parkar at Karachi, and the Tapti-Khillari at Sangvi. Herds of Scindi cows and Surati buffaloes are maintained primarily for teaching purposes at the Agricultural College, Poona. The department is subsidizing two *gowshalas* at Kandivli and Mulund for the improvement of Gir cattle. The number of premium bulls at stud is 171.

At the central cattle-breeding farm at Hosur in MADRAS, Kangayam and Scindi bulls are bred for the centre, south and west of the Presidency. The Kangayam is accepted all over the centre and south as a good general purpose animal, while the Scindi is considered suitable for mating with the non-descript cows of the West Coast. From the mixed herd of cross-breds kept on the Hosur farm, bulls are supplied to Madras and the Nilgiri Hills. The Chintaladevi farm is solely devoted to the improvement of the Ongole breed and the Guntur farm to the breeding of buffaloes.

The grading up of MYSORE cattle for milk purposes is being pursued at Hebbal. On the cattle-breeding farm in the TRAVANCORE State, pure herds of Scindi and Mysore cattle are being maintained. The Scindi has proved to be the most suitable milch cow for the State, while Halligarh bulls are much appreciated for their draught qualities. In BARODA, herds of Gir cattle and Jafferabadi buffaloes are being built up.

Sheep-breeding. Sheep-keeping is mainly a pastoral industry in India, and the 23 million head in British territory are mostly maintained on waste lands. Experiments are in progress in some provinces to grade up the indigenous sheep by selection and by cross-breeding with Merino and other superior wool breeds. On the Hissar farm in the PUNJAB, local sheep are being crossed with

Merino rams imported from Australia, and the rams sold to private breeders. The number of co-operative sheep-breeding societies established has risen to six. As the mating of a fat-tailed Pusht-i-Koh ram brought from Iraq with local Hashtnagari ewes has produced desirable crosses on the Tarnab farm in the NORTH-WEST FRONTIER PROVINCE, more rams are being imported. At Hosur in MADRAS the local breeds of pure white and black-faced white sheep are being graded up by selective breeding. The average clip per sheep has already been increased by six ounces. The second generation of Merinos in MYSORE has been found superior to the first both in the quality and quantity of wool produced.

It is a pity that nothing has, as yet, been done to improve the goat in India. There is undoubtedly great scope for improving it as a milking, hair producing and a flesh producing animal.

Poultry-breeding. The interest aroused in the possibility of poultry-breeding as a subsidiary industry to agriculture is taking a definite shape. In the PUNJAB, a post of Poultry Expert has been created and breeding started at Gurdaspur. A special poultry-breeding farm has been started at Kirkee in BOMBAY, and broods of English birds have been established in some other provinces.

CHAPTER IX.

PUBLICATIONS OF THE AGRICULTURAL DEPARTMENT.

On account of the prevailing general illiteracy in the country agricultural publications cannot be expected to reach directly any considerable number of the actual tillers of the soil. They, however, provide informative material for the lectures of the departmental demonstration staff and for the columns of vernacular newspapers. They help, too, to create an interest in agricultural literature among the literate classes and to supplement to some extent the various methods of demonstration and propaganda devised for bringing agricultural improvements to the notice of the cultivator. A complete list of agricultural publications issued during the year under review is given in Appendix XIII (page 139). Briefly summarised, those issued by the Imperial and Provincial Departments of Agriculture are as follows:—

Imperial. Thirteen memoirs, three bulletins and four other publications were issued during the year, while 21 publications were in the press on 30th June, 1927. The publications issued dealt with subjects of general interest such as the inheritance of characters in sugarcane and cotton breeding; the varieties of rice found in Burma; the effect of manuring on the vegetative and reproductive capacity of the seed; the digestibility of Indian feeding stuffs; the nutrients required by Indian cattle for growth; the absorption of moisture by soils; the selection of Burma beans for low prussic acid content; the treatment of hookworm infection in dogs, etc.

"The Agricultural Journal of India," which is issued every two months, continues to maintain its popularity among the class of readers for which it is intended.

With a view to stimulating and fostering the recently awakened interest in cattle-breeding and dairying matters, a quarterly journal called "The Journal of the Central Bureau for Animal Husbandry and Dairying in India" has been started from April 1927. Articles less technical and scientific than those considered suitable for "The Agricultural Journal of India" will ordinarily find a place in this

new Journal, and they will aim at disseminating information regarding the progress made in establishing pedigreed herds, the merits of the different breeds, new methods of growing and storing fodders in the dry state and as ensilage, animal nutrition, cattle diseases, courses of training in animal husbandry and dairying, etc. It is edited by the Agricultural Adviser to the Government of India in consultation with the Director, Military Farms, Army Headquarters, and four other Government officials. The annual subscription for four issues is Rs. 2-8-0 only. For the first number of this Journal His Excellency the Viceroy graciously wrote a Foreword which attracted much attention.

Provincial. Nine bulletins and 23 leaflets with their vernacular versions were issued in BOMBAY. Among the subjects dealt with are a practical system of storing farmyard manure, an improved method of growing termeric, lucerne as a dry crop, control of the powdery mildew of grapes, and vinegar making. The monthly digest of the operations of the MADRAS Agricultural Department was published, as before, in English and the principal vernaculars of the presidency for circulation among agriculturists. Over 79,000 copies of the Villagers' Calendar printed in five languages were also distributed and sold. The old leaflet on "Cambodia Cotton" was revised and 34,000 copies were printed in four languages for distribution. The quarterly journal of the BENGAL department continued to be published in English and Bengali. One of the leaflets issued deals with the preparation of artificial farmyard manure from waste products. The new artificial fertilizer Ammophos, which has proved extraordinarily effective as a manure for rice, formed the subject of a leaflet published in BIHAR AND ORISSA. In the UNITED PROVINCES, the publication of monthly agricultural journals in Hindi (Kisan-Upakarak) and Urdu (Mufid-ul-Mazarain) from Partabgarh was continued. The occasional publications included a practical guide to oil-engines and pamphlets on the cultivation of ground-nut and the utilization of water hyacinth. The half-yearly "Seasonal Notes" published in three languages seems to have met the demand for a periodical for agriculturists in the PUNJAB. A leaflet on the laying out of a fruit garden and another on methods of manufacturing *gur* (raw sugar) were among the other publications issued. A pamphlet on the

use of copper carbonate as a fungicide for sorghum smut was published in the CENTRAL PROVINCES. All the leaflets hitherto published by the BURMA department have been issued in two volumes both in English and Burmese, as they deal with almost every aspect of agriculture in the province. The Agricultural Calendar was published in Burmese as usual and about 6,000 copies were distributed.

CHAPTER X.

RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL DEPARTMENTS.

The total expenditure incurred by the Imperial Department of Agriculture during the financial year ending 31st March, 1927, was Rs. 14,24,777. The gross receipts of the Agricultural Research Institute, Pusa, from the sale of farm produce, cattle, milk, etc., and subscriptions to the Sugar Cable Service amounted to Rs. 87,041, and the receipts of the three dairy farms and one creamery to Rs. 4,06,649. The net expenditure incurred by the Imperial Department was thus Rs. 9,31,087.

	Rs.
General expenditure of the Pusa Institute (including the office of the Agricultural Adviser and Director)	2,67,974
Botanical Section	47,506
Chemical Section	62,671
Bacteriological Section	50,524
Mycological Section	66,540
Entomological Section	54,135
Agricultural Section	1,68,750
Sugar Bureau	21,935
Sugar Cable Service	26,949
Imperial Dairy Expert	51,109
Physiological Chemist	67,176
Government Sugarcane Expert	75,822
TOTAL	9,61,091

The receipts and expenditure of the three dairy farms and one creamery under the control of the Imperial Dairy Expert were Rs. 4,06,649 and Rs. 4,63,686, respectively, for the financial year 1926-27 as detailed below :—

Name of Farm	Receipts	Expenditure
	Rs.	Rs.
Bangalore	1,17,350	1,34,013
Wellington	79,296	90,482
Karnal	82,082	1,14,654
Anand (Creamery)	1,27,921	1,24,537
TOTAL	4,06,649	4,63,686

The following tabular statement shows the receipts and expenditure of the Provincial Departments of Agriculture for the year 1926-27. The respective figures for the previous year were Rs. 21,47,304 and Rs. 1,11,38,648.

Province	Receipts	Expenditure
	Rs.	Rs.
Bombay	2,78,100	16,46,200
Madras	2,73,856	16,65,655
Bengal	1,79,694	10,17,174
Bihar and Orissa	1,11,292	6,01,667
United Provinces	3,52,919	23,17,882
Punjab	6,14,373	21,88,651
Burma	70,489	7,63,748
Central Provinces	2,70,884	10,57,308
Assam	81,680	3,44,475
North-West Frontier Province	34,873	84,842
Baluchistan	11,798	11,442
TOTAL	22,79,958	1,16,99,044

The net expenditure of the Imperial and Provincial Departments of Agriculture combined was Rs. 1,03,50,173 which works out at about 9 pies per acre of cultivated area and 8 pies per head of population in British India. Out of a revenue of nearly 90 crores of rupees the Provincial Governments are spending a little more than 1 per cent. on the development of India's basic industry, while the net expenditure borne by the Central Government is only 0·07 per cent. of the total revenue.

In the United States of America where only 30 per cent. of the population is engaged on the land as against over 70 per cent. in British India, the amount spent on its agricultural department works out to 6 annas per acre of land under cultivation or approximately 8 times as much as India spends per acre. Of the total expenditure of about 51½ million dollars over 40 per cent. is borne by the Federal Government. It would appear that in America the Federal and States Departments are spending about 11 times as much on the development of agriculture as is being spent by

the Imperial and Provincial Departments of Agriculture in this country, and that the Federal Department's share of this expenditure is 42 times greater than the corresponding fraction representing the expenditure on agriculture borne by the Central Government in India. In Japan—a comparatively small country with a population of only 59 millions—the total expenditure budgeted for in 1927-28 is 49¾ million yen which is about 5 times the gross expenditure incurred by all the agricultural departments in India last year.

In India more money is required for agricultural research, education and demonstration and propaganda in particular but more especially for research which is and always will be the basis of all agricultural progress. The organization built up for extension work, including demonstration and propaganda, must be based on the results produced by research. We hope that the report of the Royal Commission on Agriculture to be published shortly will stress this point and draw attention to the fact that agricultural departments in India have in the past received most inadequate financial support.

That the money spent on agricultural research has proved a sound investment may be gathered from the fact that the increased value of the annual outturn resulting from the introduction of improved wheats in India is double the total net expenditure on all its departments of agriculture. The increased value resulting from the introduction of improved varieties of all kinds of crops is reckoned to be in the neighbourhood of 10½ crores of rupees or about ten times the net expenditure on all the activities of the Imperial and Provincial departments. But crop improvement is but one of the many lines of work to which our departments of agriculture are giving attention. The introduction of improved agricultural implements and cattle, of effective methods of checking crop pests and diseases, and of more intensive methods of cultivation generally, is each adding directly its quota to the increased profits reaped by the cultivator.

The departments continue to perform work of great economic value in thus providing the facilities for more profitable farming. They are, too, gradually creating among agriculturists a desire for improvements. That desire is the fruit of the diffused know-

ledge of agricultural facts and principles which have radiated from agricultural colleges, from schools, and centres for demonstration and propaganda. The departments are thus both providing facilities for the uplift of the agriculturist and preparing his mind to apply these facilities.

Indian agriculture has reached the stage at which, in order to prosper, it must progress; further progress must be based on research. The population is increasing so fast that it is imperative to make agriculture more efficient in order to retain the present standard of living. Agriculture can be made more efficient—that is to say the cost of production can be reduced and the margin of profit increased—by the application of science to its manifold problems. Should India fail to provide the number of scientific experts needed for the progressive development of her agriculture, it will be impossible to maintain even the present standard of living, for as the years roll on there will be millions of more mouths to be fed. Research workers in Agricultural Departments in India have achieved many successes: the improved varieties of cotton, wheat, sugarcane, rice and other crops already evolved are, as already pointed out, adding to her wealth each year a sum which covers many times over the amount spent on all the different branches of agricultural research put together, and the improvement of crops is but one of many lines of research which are being tackled by our agricultural experts.

In the more advanced countries of the West much attention has within the last three decades been given to the application of science to agriculture: provision has been made there both for training large numbers of research workers and for carrying out scientific investigations into every branch of husbandry. Though the British Empire has of late years made a special effort in this direction, the opinion of some of the ablest witnesses who gave evidence before the Royal Commission on Agriculture in London was that, despite the efforts made to train scientific investigators, the supply of such men was lamentably short of the needs of the Empire. India, too, is suffering from a dearth of trained men. Adequate provision has not as yet been made either for agricultural research or for training research workers. Agricultural colleges have, it is true, been opened within the last 22 years in 6 of the 9

provinces in British India; but the staffs of these colleges are mainly occupied in teaching their students the theory and practice of agriculture: for post-graduate training in research these colleges have neither the time nor the staff required. The Government of India have provided at Pusa and Bangalore post-graduate training in animal husbandry and dairying, plant-breeding, chemistry, entomology, mycology and bacteriology, and the Indian Central Cotton Committee has made provision for the training of a certain number of post-graduates in cotton research; but the total number of men being trained is very small as compared with the enormous interests at stake. The demand for such men is also so very small unfortunately, that if, under existing conditions, more research workers were to be trained, they would fail to find employment.

While it is very desirable that provision should be made in India itself for the training of research workers in agriculture and the sciences allied thereto, it does not follow that study abroad is to be discouraged. An ideal system would be that which provides for the training of promising students in India and for their being given an opportunity of studying, at a later date, the research work being done and methods of scientific investigation adopted, in more advanced countries. The standard of research could, we believe, be raised and the outlook and sympathies of Indian research workers broadened by bringing them into touch with leading scientists in other parts of the world. This period of training abroad should come not in the beginning of a young man's career as a Government servant, but after he had proved by some years of service that he had a bent for research. To train men as research workers who have no bent for investigation is a waste of time and money. Ability to pass examinations does not prove that a man is fitted for research. First class research workers are born not made.

The evidence given before the Royal Commission on Agriculture testifies to the fact that the problems of Indian agriculture are so numerous and varied that the small band of specialists on the staffs of Agricultural Departments in this country has as yet but touched the fringe of these problems. These specialists have by their researches effected improvements and collected a body of exact knowledge which affords a foundation for further progress.

based on sustained and systematic research. To accelerate progress it is of paramount importance that measures be taken to co-ordinate agricultural research throughout India and to provide facilities at central research institutions for training research workers.

APPENDIX I.

Areas under new and improved varieties of crops during 1926-27.

Name of Province	Name of crop	Advantages	Area in Acres						Remarks
			1926-27			1925-26(a)			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Bombay	Cotton—								
	1027 A. L. F.	Lint fetches a premium of Rs. 15-25 per candy (798 lb.)	165,472	300,200	465,672	142,956	300,000	442,956	
	Neglectum roseum	Early ripening; avoids frost; yields Rs. 7 more per acre.	16,565	114,738	131,303	28,930	206,970	235,900	
	Surat Cotton	Selected uniform seed	..	..	..	..	5,588	5,588	
	Dharwar No. 1	Uniform staple, higher ginning percentage. resistant to red leaf.	178,492	111,000	289,492	119,000	40,000	159,000	
	Gadag No. 1		63,000	62,000	125,000	100,000	50,000	150,000	
	Punjab-American 4 F. and 285 F.	Prolific, hardy, early, commands a premium of 12-25 per cent.	4,000	32,302	36,302	8,000	25,000	33,000	
	Desi 27 W. N.	Prolific, special rough feel, bright colour, higher ginning percentage.	7,100	20,000	27,100	16,000	1,000	17,000	
	1-A Cylindrical Boll type.	....	10	..	10	..	..	..	
	Groundnut	Early maturing, profitable rotation crop.	1,640	289,517	291,157	23,804	340,206	364,010	
	Sugarcane (Red Mauritius and Manjav).	Higher yield of cane and *gur*, do not lodge, not attacked by jackals, free from red rot.	217	2,320	2,537	264	2,000	2,264	
	Bajra (Akola)	Better quality grain and higher yield	417	..	417	125	..	125	
	Wheat (Pusa 4 and Buxi)	Better yield and less affected by smut.	1,445	14,500	15,945	1,051	12,000	13,051	
	Paddy (selected strains of Kolamba).	Higher yielding capacity	4,562	185,070	189,632	3,234	62,400	65,634	
	Miscellaneous	....	501	530	1,031	..	..	..	

Areas under new and improved varieties of crops during 1926-27—contd.

Name of Province	Name of crop	Advantages	Area in Acres						Remarks
			1926-27			1925-26(*a*)			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Madras	Paddy	Better yielders and more profitable to cultivators.	7,420	138,367	145,787	9,549	112,633	122,182	
	Sugarcane		485	10,961	11,446	2,260	18,302	20,562	
	Cotton		74,236	319,076	393,312	86,611	287,057	373,668	
	Miscellaneous		19,530	31,652	51,182	36,125	38,458	74,583	
Bengal	Paddy (Indrasail, Dudshar and Kataktara).	Capable of largely increased yields as compared with local paddy.	18,592	120,417	139,009	13,799	110,471	133,270	
	Jute (D. 154 and Chinsura Green).	Heaviest-yielding types	33,840	416,376	500,216	50,634	282,138	332,772	
	Sugarcane (Tanna and Co. 213).	Drought resistant, resists water-logging, jackals and pigs ; free from disease.	10,000	40,000	50,000	6,706	24,101	30,807	
	Other crops	More profitable to cultivators	223	621	844	105	516	621	
Bihar and Orissa	Paddy (Dahia, Kakharua, Badshabhog, Buromal, Kanke 26).	Earliness and heavy yield	989	5,119	6,108	1,820	33,720	35,540	
	Sugarcane (Co. 205, 210, 213, 214, 215, Java Hebbal).	Greater outturn in cane and sugar	522	5,915	6,436*	153	5,130	5,283	* In addition, the Sugar Bureau reports 12,000 acres under Coimbatore canes in North Bihar.
	Groundnut (No. 17)	Profitable crop even on poor land	95	1,771	1,866	118	2,052	2,170	
	Tobacco (Pusa 28)	Heavy yield and suitable for local consumption.	40	100	140	100	100	200	
	Gram (No. 4)	Heavy yield	142	2	144	57	..	57	
	Wheat (Pusa 4, 12, 100, 52, 80-5).	Greater yield	135	2,348	2,483	43	685	728	
	Dhaincha	Economical green manure	..	7,020	7,020	47	7,010	7,057	
	Other crops (Soybeans, Maize Kalimpong, Potato Alnvick Castle).	Improved varieties	52	1	53	..	..	..	

United Provinces	Wheat (Pusa 4, 12, 52, 54, 110, C.13, 46 Muzaffarnagar, etc.)	High yielding and rust resisting; not liable to lodge as *desi* varieties.	50,000	950,000	1,000,000	44,138	800,000	844,138	
	Cotton (J. N. 1, K. 22, A. 19, A. W. F., C. 204 and 1031, American cotton, etc.	Superior to *desi* cotton; better lint and higher ginning percentage.	10,000	200,000	210,000	17,134	28,550	45,684	
	Sugarcane (S. 48, Co. 205, 213, 214, 290, Uba, Barbados, Mauritius 16, etc.)	Give more outturn of cane per acre and 50 per cent. of *gur* more than the local varieties.	15,000	100,000	115,000	7,740	92,260	100,000	
	Barley (Ballia, etc.)	Better yielder than local varieties	22,000	2,000	24,000	20,407	..	20,407	
	Gram (Pusa yellow, black, etc.)	Produce and quality better than local varieties.	20,000	20,000	40,000	26,301	9,879	36,180	
	Miscellaneous (Jaunpur maize, Cawnpore Dudania *juar*, awned *bajra*, large Japanese and Virginian bunch groundnuts, jute, etc.)	Better yielders than local varieties	36,000	30,000	66,000†	34,263	12,646	46,909	†Besides, there are 96,000 acres more under different crops, details of which are not available.
Punjab	Cotton—								
	American 4 F.	Long-stapled variety, yields more than *desi* cottons and fetches a premium of Rs. 3-6 per maund of seed cotton.	180,960	941,040	1,122,000	..	..	1,131,800	
	American 285 F.	Spins finer than 4 F. and also more drought-resistant and earlier.	3,200	6,700	9,900	..	..	10,450	
	Desi No. 24	Improved *desi* variety	23,900	119,100	143,000	..	..	85,700	
	White-flowered neglectum.	More yield and higher lint percentage.	23,780	104,920	128,700	..	..	55,800	
	Wheat (Punjab 11, 17, 8 A, Pusa 4, 12).	More yield, fetch better price, possess good milling and baking qualities, ripen early.	85,285	1,355,004	1,440,289	..	..	1,470,037	
	Sugarcane (Bihar, Co. 205 and 223).	High yield	4,805	2,846	7,651	..	..	11,020	
Burma	Paddy	Higher yield, freedom from red grain and higher milling outturn.	141,138	146,801	287,939	..	..	179,981	
	Groundnut	High oil capacity, early maturity, good yield, easy to harvest.	2,231	19,976	22,207	..	..	6,298	
	Cotton (Indigenous selection and Cambodia).	Longer and finer staple, higher ginning percentage.	3,558	1,400	4,958	..	..	8,785	
	Gram	Immunity to wilt disease and higher yield.	4,860	70,304	75,164	..	..	59,361	Probably very much under-estimated.

Areas under new and improved varieties of crops during 1926-27—concld.

Name of Province	Name of crop	Advantages	Area in Acres						Remarks
			1926-27			1925-26(a)			
			Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total	
Central Provinces	Wheat	Better yielders	..	..	135,148	..	..	125,138	Figures based on seed farms only. Actuals under improved seed 3-4 times the figure.
	Paddy		..	..	104,256	..	..	108,057	Ditto.
	Cotton		..	..	500,019	..	..	514,904	Largely based on seed issued from recognized seed farms.
	Juar (Sorghum)		..	..	80,482	..	..	65,080	
	Groundnut		..	..	44,262	..	..	28,691	
	Other crops		..	..	7,122	..	..	2,554	
Assam	Paddy	Higher yielders than *desi* varieties	879	8,937	9,816	697	7,839	8,536	
	Jute		1,015	3,828	4,843	1,150	4,015	5,165	
	Sugarcane		77	2,242	2,319	66	2,127	2,193	
	Potato		4,966	5,270	10,236	4,558	4,978	9,536	
North-West Frontier Province.	Wheat (Pusa 4)	Ripens early, yields well, does not lodge, resists rust.	..	..	300,000	..	..	202,000	
	Sugarcane (Red Assami)	Ripens early, is vigorous and little affected by diseases and insects.	..	..	600	..	..	800	
	Berseem	Yields better than shaftal and is less liable to cause hoven.	..	..	10,000	..	..	8,000	
	Fruits	Superior varieties	..	..	1,000	..	..	800	
	Maize	Ditto	..	..	5,000	..	..	6,000	

(a) Revised figures.

APPENDIX II.

List of Agricultural Stations in British India in 1926-27.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bombay	Surat	292	Superintendent	Deputy Director of Agriculture, Gujarat, Surat.	Cotton and *juar* research station.
	Amalsad	19	Agricultural Overseer		Sugarcane farm.
	Nadiad	8	Tobacco Breeder		Tobacco farm.
	Broach	6	Cotton Breeder, South Gujarat.		Cotton and *juar* farm.
	Dohad	57	Superintendent		Cotton farm.
	Viramgam	6	Cotton Breeder, North Gujarat.		Wagad cotton breeding.
	Dhulia	28	Headmaster, Vernacular Agricultural School.	Deputy Director of Agriculture, North Central Division, Nasik.	Vernacular Agricultural School.
	Jalgaon	204	Superintendent		Seed farm.
	Kopargaon	52	Ditto	Deputy Director of Agriculture, South Central Division, Poona.	Sugarcane station.
	Baramati	21	Ditto		Sugarcane farm.
	Manjri	62	Ditto		Sugarcane experimental station.
	Mohol	49	Overseer		Testing and showing methods of dry cultivation.
	Dharwar	134	Superintendent	Deputy Director of Agriculture, Southern Division, Dharwar.	
	Gokak Canal (Arbhavi)	62	Ditto		
	Mugad	9	Ditto		Rice breeding farm.
	Tegur	370	Fieldman		Cattle breeding farm.
	Chharodi	2,251	Manager	Livestock Expert to Government, Bombay, Poona.	Kankrej cattle breeding farm.
	Bankapur	256	Ditto		Amrit Mahal cattle breeding farm.

List of Agricultural Stations in British India in 1926-27—contd.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bombay	Ratnagiri	93	Superintendent	Deputy Director of Agriculture, Konkan, Ratnagiri.	Rice and *nagli* breeding farm.
	Kumta	22	Ditto		
	Karjat	9	Rice Specialist		
	Karjat	6	Superintendent	Crop Botanist to Government, Bombay, Poona.	Rice breeding station.
	Kirkee	2	Ditto		Wheat breeding station.
	Karachi (Willingdon Cattle Farm).	*800*	*Manager*	Deputy Director of Agriculture, Sind, Karachi.	Scindi cattle breeding farm.
	Mirpurkhas	200	Superintendent		
	Mirpurkhas	60	Ditto		
	Sukkur	30	Ditto		
	Larkana	65	Ditto		
	Jacobabad	300	Ditto		Wheat farm.
	Ganeshkhind, Kirkee	80	Ditto	Horticulturist to Government, Bombay, Poona.	Botanical garden.
	Modibag, Poona	11	Ditto		Teaching and research fruit farm.
	Poona	289	Ditto	Professor of Agriculture, Poona Agricultural College.	Agricultural College farm.
	Kirkee	362	Manager		Agricultural College dairy.
	Coimbatore	440	Farm Manager	Superintendent, Central Farm, Coimbatore.	Central farm attached to the Agricultural College.
	Samalkota	57	Ditto	Deputy Director of Agriculture, I Circle, Vizagapatam.	
	Anakapalli	41	Ditto		
	Guntur	150	Ditto	Deputy Director of Agriculture, II Circle, Guntur.	
	Hagari	225	Ditto	Deputy Director of Agriculture, III Circle, Bellary.	
	Nandyal	102	Ditto		

Madras	Palur	64	Ditto	Deputy Director of Agriculture, IV Circle, St. Thomas Mount.	Groundnut station.
	Palakuppam	16	Ditto		
	Koilpatti	125	Ditto	Deputy Director of Agriculture, VI Circle, Madura.	Now a cotton breeding station.
	Kasargod	106	Ditto	Deputy Director of Agriculture, VII Circle, Tellicherry.	West Coast coconut station.
	Taliparamba	86	Ditto		
	Vellalore	2	Ditto	Deputy Director of Agriculture, VIII Circle, Coimbatore.	Betel vine station.
	Nanjanad	36	Manager	Curator, Government Botanic Gardens, Ootacamund.	Seed potato farm.
	Coonoor	..	Assistant Manager		Pomological station.
	Chintaladevi	850	Manager	Deputy Director, Live-stock, Hosur.	Cattle farm.
	Guntur	150	Assistant Manager		Buffalo breeding station.
	Hosur	1,635	Manager		Central cattle farm.
	Chinsura	210	Farm Superintendent	Deputy Director of Agriculture, Western Circle.	
	Burdwan	35	District Agricultural Officer		
	Berhampore	44	Ditto		
	Bankura	29	Ditto		
	Suri	33	Ditto		
	Jessore	5	Ditto		
	Gosaba	8	Agricultural Demonstrator		
Bengal	Dacca	354	Chief Farm Superintendent	Deputy Director of Agriculture, Eastern Circle.	
	Mymensingh	20	District Agricultural Officer		
	Faridpur	20	Ditto		
	Comilla	20	Ditto		
	Barisal	20	Ditto		
	Kishoregunj	83	Ditto		
	Jamalpur	27	Ditto		
	Dhanbari	7	Agricultural Demonstrator		
	Rajshahi	63	District Agricultural Officer	Deputy Director of Agriculture, Northern Circle.	

List of Agricultural Stations in British India in 1926-27—contd.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Bengal	Rangpur Demonstration Farm.	19	District Agricultural Officer	Deputy Director of Agriculture, Northern Circle.	
	Bogra (old)	23	Ditto		
	Bogra (new)	6	Ditto		
	Pabna	20	Ditto		
	Dinajpur	24	Ditto		
	Mainaguri	25	Ditto		
	Malda	15	Ditto		
	Rangpur Cattle Farm	333	Farm Superintendent	Live-stock Expert.	Cattle farm.
	Rangpur Tobacco Farm	52	District Agricultural Officer	Agricultural Chemist	Tobacco farm.
	Kalimpong	76	Manager	Director of Agriculture.	
	Kalimpong		Superintendent of Sericulture.	Deputy Director of Sericulture	Sericultural research stations.
	Kurseong				
	Berhampore				
	Cuttack	150	Manager	Deputy Director of Agriculture, Orissa Range, Cuttack.	
	Khurda	31	Overseer		
	Balasore	75	Ditto		
	Angul	47	Ditto		
	Puri	42	Ditto		
	Anantpur	4	Ditto		
	Sepaya	379	Manager	Deputy Director of Agriculture, Western North Bihar Range, Sepaya.	
	Siwan	25	Overseer		
	Darbhanga	26	Ditto		

Bihar and Orissa	Sabour	190	Probationary Assistant Director of Agriculture.	Director of Agriculture.	
	Jamui	38	Overseer	Assistant Director of Agriculture, Eastern South Bihar Range, Sabour.	
	Banka	26	Ditto		
	Monghyr	200	Superintendent	Superintendent	Dairy farm.
	Gaya	193	Manager	Deputy Director of Agriculture, Western South Bihar Range, Gaya.	
	Nawadah	67	Overseer		
	Likramganj	24	Ditto		
	Siris	31	Ditto		
	Kanke	340	Manager	Deputy Director of Agriculture, Chota Nagpur Range, Kanke.	
	Netarhat	193	Ditto		
	Purulia	52	Overseer		
	Ramgarh	43	Ditto		
	Chianki	32	Ditto		
	Sambalpur	32	Ditto		
	Chaibassa	38	Ditto		
United Provinces	Shahjahanpur	163	Ditto	Deputy Director of Agriculture, Rohilkhand Circle.	
	Jeolikote (Naini Tal)	51	Inspector		
	Nawabganj (Bareilly)	119	Ditto		
	Nagina (Bijnor)	77	Superintendent		
	Cawnpore	71	Ditto	Deputy Director of Agriculture, Central Circle, Cawnpore.	
	Kalianpur (Cawnpore)	263	Ditto		
	Mainpuri	53	Ditto		
	Etawah	61	Ditto		
	Hardoi	55	Ditto		
	Atarra (Banda)	171	Ditto	Deputy Director of Agriculture, Bundelkhand.	
	Jaitpur (Hamirpur)	30	Overseer		
	Partabgarh	90	Superintendent	Deputy Director of Agriculture, Eastern Circle, Partabgarh.	

List of Agricultural Stations in British India in 1926-27—contd.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
United Provinces	Naugawan (Sultanpur)	400	Superintendent	Deputy Director of Agriculture, Eastern Circle, Partabgarh.	
	Fyzabad	206	Ditto		
	Rae Bareli	12	Ditto		
	Benares	78	Ditto		
	Aligarh	88	Ditto	Deputy Director of Agriculture, Western Circle, Aligarh.	
	Kalai (Aligarh)	142	Ditto		
	Muzaffarnagar	100	Ditto		
	Bichpuri (Agra)	100	Ditto		
	Jachonda (Muttra)	36	Inspector		
	Bulandshahr	25	Ditto		
	Gorakhpur	110	Overseer	Deputy Director of Agriculture, North Eastern Circle, Gorakhpur.	
	Bahraich	102	Ditto		
Punjab	Lyallpur—				
	Agricultural Farm	473	Manager	Professor of Agriculture, Punjab, Lyallpur.	
	Students' Farm	78			
	Botanical Farm	100	Associate Professor of Botany, Cerealist, Fodder Specialist, Fruit Specialist.	Associate Professor of Botany, Lyallpur.	
	Risalewala	1,078	Manager	Professor of Agriculture, Punjab, Lyallpur.	
	Montgomery	546	Agricultural Assistant	Deputy Director of Agriculture, Montgomery.	Mainly a seed farm.
	Shergarh	261	Ditto		Demonstration farm.
	Raewind	46	Ditto		District Board demonstration farm.
	Gurdaspur	161	Ditto	Deputy Director of Agriculture, Gurdaspur.	Experimental station.
	Beas	43	Ditto		Demonstration farm.
	Kala Shah Kaku	146	Ditto		Rice breeding station.

Punjab	Sargodha	657	Ditto	Deputy Director of Agriculture, Rawalpindi.	Experimental station and seed farm.
	Chillianwala	250	Ditto		Seed farm.
	Gujrat	50	Ditto		Demonstration farm.
	Hansi	589	Ditto	Deputy Director of Agriculture, Hansi.	Experimental station.
	Sirsa	419	Ditto		Ditto.
	Multan	529	Ditto	Deputy Director of Agriculture, Multan.	
	Harappa Road	558	Ditto	Deputy Director of Agriculture, Montgomery.	For reclamation of saline soils.
Central Provinces	Nagpur	268	Superintendent	Principal, Agricultural College, Nagpur.	College farm.
	Akola	271	Ditto	Economic Botanist, Nagpur.	
	Borgaon	368	Ditto	Deputy Director of Agriculture, Western Circle, Amraoti.	
	Yeotmal	106	Ditto		
	Khandwa	177	Ditto		
	Basim	109	Ditto		
	Sindewahi	197	Ditto	Deputy Director of Agriculture, Southern Circle, Nagpur.	
	Tharsa	116	Ditto		
	Wara-Seoni	63	Ditto		
	Telinkheri	1,000	Ditto	Deputy Director of Agriculture, in charge Animal Husbandry, Nagpur.	Dairy farm.
	Raigarh (Garhi)	1,200	Ditto		Cattle breeding farm.
	Chandkhuri	333	Ditto	Deputy Director of Agriculture, Eastern Circle, Raipur.	
	Bilaspur	253	Ditto		
	Drug	281	Ditto		
	Raipur	229	Ditto		
	Seoni	164	Ditto	Assistant Director of Agriculture, Chhindwara.	
	Chhindwara	69	Ditto		
	Betul	161	Ditto		

List of Agricultural Stations in British India in 1926-27—concld.

Province	Agricultural Station	Area in acres	Officer in immediate charge	Supervising Officer	Remarks
Central Provinces	Powarkhera (Hoshangabad)	528	Superintendent	Deputy Director of Agriculture, Northern Circle, Jubbulpur.	
	Adhartal (Jubbulpur)	637	Ditto		
	Saugor	161	Ditto		
	Damoh	152	Ditto		
Burma	Mandalay	630	Ditto	Professor of Agriculture, Mandalay Agricultural College.	Central experimental farm.
	Tatkon	106	Ditto	Deputy Director of Agriculture, East Central Circle.	
	Pyinmana	55	Ditto		
	Yawnghwe	37	Ditto		
	Mahlaing	254	Ditto	Deputy Director of Agriculture, Myingyan Circle.	
	Padu	105	Ditto		
	Allanmyo	144	Ditto	Deputy Director of Agriculture, West Central Circle.	
	Pwinbyu	22	Ditto		
	Sa-aing	12	Ditto		
	Hmawbi	456	Ditto	Deputy Director of Agriculture, Southern Circle.	
	Pegu	131	Ditto		Seed farm.
	Paungde	126	Ditto		Ditto.
	Akyab	138	Ditto	Deputy Director of Agriculture, Arakan Circle.	
	Kyaukpyu	22	Ditto		
	Myaungmya	92	Ditto	Deputy Director of Agriculture, Irrawaddy Circle.	
	Henzada	148	Ditto		Seed farm.
	Maubin	155	Ditto		Ditto.

Burma	Mudon	88	Ditto	Deputy Director of Agriculture, Tenassorim Circle.	
	Thaton	195	Ditto		Seed farm.
	Paukkaung	16	Ditto	Entomologist	Experimental farm for mulberry plantation.
Assam	Jorhat	59	Manager	Deputy Director of Agriculture, Assam.	Sugarcane station.
	Titabor	120	Ditto		Rice station.
	Upper Shillong	367	Ditto		Potato station.
	Karimganj	80	Ditto		Rice station.
	Khanapara	200	Ditto		Cattle breeding farm.
North-West Frontier Province	Tarnab (Peshawar)	200	Ditto	Agricultural Officer, North-West Frontier Province, Tarnab.	
	Haripur	20	Ditto		
Imperial Department of Agriculture	Pusa	800	Overseer	Imperial Agriculturist.	
	Bangalore	258	Superintendent	Imperial Dairy Expert	Dairy farms.
	Wellington	69	Ditto		
	Karnal	2,154	Ditto		
	Coimbatore	90	Farm Manager	Government Sugarcane Expert	Imperial Sugarcane Station.

APPENDIX III.

Staff of the Provincial Departments of Agriculture in India during 1926-27.

Province	RESEARCH AND TEACHING STAFF						DISTRICT STAFF					
	SUPERIOR SERVICE (IN AND OUTSIDE I. A. S.)		PROVINCIAL SERVICE		SUBORDINATE SERVICE		SUPERIOR SERVICE (IN AND OUTSIDE I. A. S.)		PROVINCIAL SERVICE		SUBORDINATE SERVICE	
	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled Substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively
Bombay	6	6	15	15	21	21	8	8	9	9	234+38	234+38
Madras	13	8	18	18	77	75	11	8	11	11	222	212
Bengal.	6	5	3	3	32	32	3	1	5	4	147	131
Bihar and Orissa . . .	2	..	3	3	2	1	12	7	10	7	89	86
United Provinces . . .	9	5	9	9	36	36	12+3	5+3	14+4	13+4	104+238	104+238
Punjab	15	11	18	16	53	16	15	8	17	15	102	16
Central Provinces . . .	5	4	4	4	18	16	8	6	9	9	106	106
Burma	5	3	8	5	18	14	11	8	12	6	59	19
Assam	2	1	..	..	9	9	3	1	3	3	81	80
North-West Frontier Province	1	1	..	..	6	5	..	..	..	..	..	..

APPENDIX IV.

Showing results of well-boring during 1926-27.

Province	1926-27		1925-26	
	Number of bores	Number successful	Number of bores	Number successful
Bombay	193	113	206	116
Madras	768	584	508	345
Bengal	21	14	8	7
Bihar and Orissa	184	179	154	134
United Provinces	1,017	759	673	510
Punjab	584	476	284	225
Burma	....	....	1	1
Central Provinces	2	....	....	....

APPENDIX V.

Showing sale of improved implements through departmental agency during 1926-27.

Province	Ploughs		Cane Mills		Fodder Cutters		Hoes		Other implements		Spare parts	
	1926-27	1925-26	1926-27	1925-26	1926-27	1925-26	1926-27	1925-26	1926-27	1925-26	1926-27	1925-26
Bombay	174	1,399	52	30	23	8	7	92	383	312	344	311
Madras	1,085	1,713	26	6	44	33	2	4	102	415	3,426	2,597
Bengal	10	7	6	5	3	2	5	3	1	5	..	3
Bihar and Orissa . . .	..	1	..	2	4	..	..	..	..	3	..	..
United Provinces . . .	3,321	3,212	113	116	50	35	15	15	320	316	5,395	5,130
Punjab	7,868	5,410	612	280	2,707	1,487	130	94	2,249	3,887	2,545	3,181
Central Provinces . . .	4,474	4,262	240	199	19	31	402	678	500	389	7,618	4,397
Burma	2,534	485	9	1	4	45	10	..	40	75	482	1,355
Assam	14	8	184	159	..	..	..	..	52	50	..	..

APPENDIX VI.

Improved seed and manures distributed through departmental agency during 1926-27.

Province	SEED DISTRIBUTED						MANURES DISTRIBUTED			
	GRAIN SEED IN CWT.		WHOLE CANES (No.)		FRUIT PLANTS (No.)		COMMERCIAL FERTILIZERS IN CWT.		CAKES IN CWT.	
	1926-27	1925-26	1926-27	1925-26	1926-27	1925-26	1926-27	1925-26	1926-27	1925-26
Bombay	3,497	..	56,389	..	46,508	..	786	..	560	..
Madras	16,925	13,066	6,218,490 +674 cwt.	5,376,108 +1,960 cwt.	33,771	13,416	14,415	5,973	83,723	808
Bengal	4,903	4,431	1,402,000	854,110	288	565	506	119	100	50
United Provinces	50,230	..	117,680 cwt.	..	31,054	23,220	1,800	..	7,580	..
Central Provinces	178,195	134,098	1,112,025	739,856	..	..	..	..	..	..
Burma	32,303	24,795	36,520	11,464	300	20	46	39	..	..
Assam	3,377	3,523	67,750	260,500	1,988	4,089	1,169	1,442	70	41
North-West Frontier Province	140	150	15 cwt.	..	30,000	30,812	..	..	..	..

NOTE.—Figures for the Punjab and Bihar and Orissa are not available.

APPENDIX VII.

Demonstration and propaganda work during 1926-27.

Province	Number of agricultural shows held		Number of practical demonstrations carried out		Number of illustrated lectures given	
	1926-27	1925-26	1926-27	1925-26	1926-27	1925-26
Bombay	36	--	1,402	--	66	--
Madras	282	243	4,683	3,820	214	218
Bengal	17	21	1,237	864	60	29
Bihar and Orissa	2	1	1,212	637	2	1
United Provinces	68	48	32,774	34,455	65	12
Central Provinces	34	32	3,446	2,405	54	61
Burma	26	19	1,017	564	386	162
Assam	5	6	2,209	1,652	26	14
North-West Frontier Province	..	..	— 3	..	8	--

NOTE.—Figures for the Punjab are not available.

APPENDIX VIII.

Agricultural Colleges and Schools in British India during 1926-27.

Name of College or School	Courses of instruction	1926-27				1925-26				Remarks
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
					(a) Post-graduate Training Institutions.					
Agricultural Research Institute, Pusa.	Two-year Post-graduate Course.	35	1	10	4	28	6	10	2	
Imperial Institute of Animal Husbandry and Dairying, Bangalore.	(1) Fifteen-month Post-graduate Course.	..	5	6	1	6	1	3	2	
	(2) Two-year Indian Dairy Diploma Course.	9	9	33	5	60	23	36	9	
	(3) Short Courses, Animal Husbandry and Co-operative Dairying for varying periods.	17	17	17	17	62	62	65	57	
					(b) Provincial Agricultural Colleges.					
Agricultural College, Poona.	(1) Three-year B. Ag. Degree Course.	135	110	201	27	136	108	200	25	Affiliated to the University of Bombay.
	(2) College Diploma Course.	..	..	..	4	..	..	..	9	
Agricultural College, Coimbatore.	Three-year B.Sc. Ag. Degree Course.	214	40	82	19	68	25	48	7	Affiliated to the University of Madras.
Agricultural College, Cawnpore.	(1) Four-year L. Ag. Diploma Course.	127	34	92	9	78	31	78	20	
	(2) Two-year Certificate Course.	58	26	56	27	80	35	50	12	
Punjab Agricultural College, Lyallpur.	(1) Four-year B.Sc. Ag. Degree Course.	493	83	225	50	400	67	169	25	Affiliated to the University of Punjab.
	(2) One-and-a-half year M.Sc. Degree Course.					..	..	..	..	
	(3) Two-year Certificate Course.					15	15	12	9	
	(4) Six-month Vernacular Course (Winter class).	70	42	42	38	38	31	21	18	
	(5) One-month Rural Economy Course.	15	15	15	15	16	16	14	14	
	(6) Ten-and-a-half month Teachers' Training Course.	45	34	32	32	40	30	30	30	

Agricultural Colleges and Schools in British India during 1926-27—concld.

Name of College or School	Courses of instruction	1926-27				1925-26				Remarks
		Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total number on the roll	Number passed in final examination	
Punjab Agricultural Colleges, Lyallpur.	(7) Six-week Blacksmith class.	42	22	14	14	15	15	11	11	
	(8) Six-month Vernacular Course (Summer class).	85	45	39	Not yet out	..	..	..	..	
Agricultural College, Nagpur.	(1) Three-and-a-half year Diploma Course.	173	64	47	7	97	51	82	5	Affiliated to Nagpur University.
	(2) Two-year Certificate Course.	16	9	9	7	20	13	25	7	
Agricultural College, Mandalay.	Three-year Diploma Course.	35	18	40	11	38	22	48	..	Final Diploma examination was held for the first time in March, 1927.
Bombay.					(c) *Agricultural Schools.*					
Vernacular Agricultural School, Loni Kalbhor (in Marathi).	Two-year Course . .	105	26	48	14	80	32	40	12	
Vernacular Agricultural School, Devihosur (in Kanarese).	Ditto . .	75	17	31	14	83	15	26	11	
Vernacular Agricultural School, Jambul (in Marathi).	Ditto . .	45	20	22	9	30	13	25	12	
Vernacular Agricultural School, Godhra (in Gujarati).	Ditto . .	51	16	30	11	42	19	30	14	
Vernacular Agricultural School, Dhulia (in Marathi).	Ditto . .	45	16	32	10	40	24	29	12	
Vernacular Agricultural School, Surat (in Gujarati).	Ditto . .	40	16	31	15	35	14	31	8	

Madras.										
Agricultural Middle School, Taliparamba.	Two year Course . .	34	19	17	4	24	14	31	18	
Agricultural Middle School, Anakapalli.	Ditto . .	12	12	1	6	35	12	17	10	
Bengal.										
Secondary Agricultural School, Dacca.	Two-year course for regular students and one-year course for Demonstrators.	33	7	11	7	21	22	21	8	
United Provinces.										
Vernacular Agricultural School, Bulandshahr.	(1) Two-year Vernacular Course .	55	30	87	10	54	30	54	17	
	(2) Teachers' Training class.	..	..		11	..	..		10	
	(3) Fieldmen's Course .	18	7		7	18	10		..	
	(4) Engine Drivers' Course.	12	5		4	13	5		..	
Central Provinces.										
Agricultural Middle School, Powarkhera.	Four-year Course . .	52	41	53	3	38	20	36	3	
Burma.										
Agricultural School, Pyinmana.	Four-year Course . .	..	64	55	18	23	73	..	..	The school is run by the American Baptist Mission and subsidized by Government.
Central Farm School, Hmawbi.	(1) Horticultural class .	10	10	10	5	8	8	10	2	
	(2) Short courses of practical instruction.	..	80	80	..	..	80	80	..	
Central Farm School, Mahlaing.	(1) One-year course .	..	..	..	..	..	1	1	..	
	(2) Short courses of practical instruction.	..	13	13	13	..	14	14	..	
Central Farm School, Tatkon.	Short courses of practical instruction.	2	2	2	..	..	5	5	..	
Central Farm School, Padu.	Ditto .	32	10	10	..	..	9	9	..	
Central Farm School, Allanmyo.	Ditto .	..	..	..	..	..	18	18	..	

APPENDIX IX.

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1926-27.

The two tables below include Agricultural Societies for—

A. 1. *Purchase and Purchase and Sale.* These are societies intended to facilitate the purchase of agricultural requisites for members, such as societies which purchase seed, manure, implements, etc., for sale to their members. Societies of this character which collect for joint sale the produce of members without making this their main object are also included in this class.

2. *Production.* These are societies which have for their chief object an act of production without proposing to themselves sale as a direct object. These also include societies for joint irrigation, for collective use of machinery, for assistance in horse and cattle breeding, etc.

3. *Production and Sale.* This class includes societies in which these two functions are united or in which one or the other predominates, it being impossible to make a clear distinction between them. It covers all societies whose main object is the joint sale of any commodity whether such commodity is produced or worked up or prepared for sale by the society itself or by the members individually. It comprises all co-operative creameries and distilleries, as well as societies whose main object is the sale of grain, cattle, eggs, *ghi*, etc., produced by their members.

4. Other forms of co-operation except insurance.

B. Insurance.

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1926-27.

(A) PURCHASE, SALE AND PRODUCTION.

Province	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit and loss for the year	REMARKS
				Rs.	Rs.	Rs.	Rs.	
Bombay	Purchase, and purchase and sale.	76	3,600	56,517	991	1,81,571	—487	
	Production	19	639	..	..	21,105	—396	
	Production and sale	88	12,609	2,61,199	7,80,327	12,86,250	+33,035	
	Others	81	23,047	14,247	4,126	2,64,166	+12,429	
	TOTAL	264	39,895	3,31,963	7,85,444	17,53,092	+44,581	
Madras	Purchase, and purchase and sale.	116	10,176	1,51,429	..	6,65,296	—16,355	
	Production and sale	16	660	3,766	..	1,69,186	—14,050	
	Others	300	18,028	..	..	3,13,945	+514	
	TOTAL	432	28,864	1,55,194	..	11,48,427	—29,891	
Bengal	Purchase, and purchase and sale.	78	20,553	34,52,157	35,21,555	8,91,844	—54,918	
	Production	377	13,328	238	—	2,55,288	—28,295	
	Production and sale	101	8,120	1,55,677	6,93,311	5,59,569	+2,41,199	
	Others	32	8,796	7,265	1,492	42,910	+866	
	TOTAL	588	50,797	36,15,337	42,16,358	17,49,611	+1,58,852	

Operations of Non-Credit Agricultural Co-operative Societies in British India during 1926-27—concld.

(A) PURCHASE, SALE AND PRODUCTION—*concld.*

Province	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit and loss for the year	REMARKS
				Rs.	Rs.	Rs.	Rs.	
Bihar and Orissa	Purchase, and purchase and sale.	9	507	5,404	1,182	8,416	—789	
	Production	4	101	..	..	12,290	..	
	Production and sale	14	217	1,057	1,871	13,531	—3,802	
	Others (grain golas)	91	27,532	..	..	1,91,557*	+7,598†	*and 65,473 md. of grain. †and profit of 9,642 md. of grain.
	TOTAL	118	28,357	6,461	3,053	2,25,794	+3,007	
United Provinces	Production and sale	3	27	3,421	2,865	11,684	+190	
	Others	3	46	..	..	..	..	
	TOTAL	6	73	3,421	2,865	11,684	+190	
Punjab	Purchase, purchase and sale.	10	663	62,988	65,438	23,707	+6,194	
	Production	233	4,947	..	..	5,241	+428	
	Production and sale	439	20,315	8,28,865	37,50,433	5,07,696	+10,983	
	Others	20	462	..	..	46,460	+2,611	
	TOTAL	702	26,387	8,91,853	38,15,871	5,83,104	+20,216	

Burma	Purchase, and Purchase and sale.	19	1,301	20,327	24,891	54,541	—4,819
	Production	6	180	..	..	..	..
	Production and sale	48	4,233	8,420	13,191	3,95,269	—63,082
	TOTAL	73	5,714	28,747	38,082	4,49,810	—67,901
Central Provinces and Berar.	Purchase and sale	12	1,045	51,836	..	53,065	+885
	Production	4	43	1,244	..	356	..
	Production and sale	3	332	9,373	..	12,581	+1,650
	TOTAL	19	1,420	62,453	..	66,002	+2,535

(B) CATTLE INSURANCE.

Province	Number of societies	Amount of risk insured	Premia collected during the year	Supplementary contributions collected	NUMBER OF ANIMALS		Claims paid	Cost of management	Funds in hand at the end of year	Amount of risk re-insured	Amount of premia paid for re-insurance
					Insured	Lost					
		Rs.	Rs.				Rs.	Rs.	Rs.	Rs.	Rs.
Bombay	8	4,830	241	..	102	2	46	62	1,543	..	..
Madras	4	105	6	..	5	5	..	8	42	..	..
Burma	390	19,140	612	..	302	11	464	127	39,482	5,860	173
	1*	5,860	555	..	793	35	407	1,096	15,540	..	..

* Central Reinsurance Society.

APPENDIX X.

Showing the working of the Provincial Veterinary Departments during 1926-27.

Province	Reported mortality from contagious diseases			Dispensaries and Hospitals			District work					
	Rinderpest	Other diseases	Total	Number of institutions	Cases treated	Castrations performed	Cases treated	Castrations performed	Outbreaks in which inoculation was undertaken	Deaths uninoculated	Inoculations	Deaths after inoculation
Bombay	7,002	4,611	11,613	103	181,166	10,928	50,519	9,985	332	4,953	33,665	84
Madras	23,676	35,478	59,154*	87	117,272	3,424	39,041	4,866	1,078	20,620	229,067	692
Bengal	33,405	2,472	35,877	45	69,311	108	126,600	61	1,171	29,148	208,244	1,988
Bihar and Orissa	4,674	4,644	9,318	31	52,842	1,612	108,068	1,119	803	3,859	147,731	196
United Provinces	22,110	8,679	30,789	149	242,157	2,905	57,670	276	1,168	19,151	160,765	500
Punjab	27,729	17,667	45,396	219	797,115	104,219	129,803	114,165	2,351	15,852	534,164	425
Burma	39,933	4,108	44,041	5	15,180	11	174,511	—	506	5,337	61,869	1,261
Central Provinces	8,391	11,940	20,331	95	310,154	4,179	389,955	55,378	666	4,944	79,806	136
Assam	33,237	19,719	52,956	3	4,696	147	78,057	1,591	565	14,778	42,413	752
North-West Frontier Province	1,715	1,921	3,636	17	64,495	5,366	38,096	22,044	52	782	14,372	11
Sind	1,720	2,477	4,197	18	30,199	268	4,990	668	141	1,145	12,688	55
Baluchistan	125	4,871	4,996	12	16,893	113	28,893	2	9	774	2,429	—
Rajputana	—	27	27	2	2,998	8	53	—	—	—	—	—
Total for 1926-27	203,717	118,614	322,331	786	1,904,478	133,288	1,226,256	210,155	8,842	121,343	1,527,213	6,160
Total for 1925-26	277,931	121,914	399,845	720	1,742,048	99,472	1,097,640	183,354	10,082	126,778	1,550,199	4,603

* Including zemindari tracts not previously accounted for.

APPENDIX XI.

Showing the details as to Students of Veterinary Colleges and Schools in India during 1926-27.

Veterinary College or School	Course of instruction	Number of Students						Students admitted during the year, classed by educational qualifications		
		Admitted during the year		Passed final examination during the year	Failed to pass final examination	Remaining under instruction at end of the year		Matriculates, school finals or with higher qualifications	Knowing some English but not matriculates	Knowing no English or very little English
		Scholarship holders	Others			In ordinary course	Instruction prolonged by reason of failure to pass			
Bombay Veterinary College	3 years' English Course.	10	29	16	10	74	17	29	10	..
Bengal „ „	Do.	25	36	28	20	58	38	41	20	—
Madras „ „	Do.	15	21	11	7	40	20	36	—	—
	Post Diploma Course.	6	..	6	..	..	..	..	..	..
Punjab „ „	4 years' English Course.	12	28	4	4	45	52	40	—	—
	Post Diploma Course.	8	..	..	..	..	..	..	..	..
Insein „ School	3 years' Vernacular Course.	20	..	15	..	14	..	..	..	20
Taunggyi „ „	1½ years' Vernacular Course.	2	..	5	4	6	4	..	..	2

APPENDIX XII.

Showing the number of cattle issued from Government farms during 1926-27.

Province	Bulls	Cows	Male buffaloes	She buffaloes	Young stock	Total for 1926-27	Total for 1925-26
Bombay	61	105	2	..	106	274	87
Madras	23	20	1	1	10	64	21
Bengal	15	..	..	..	2	17	62
Bihar and Orissa	7	28	4	..	10	49	21
United Provinces	228	36	..	..	..	264	100
Punjab	354	..	..	..	82	436	760
Burma	..	2	..	..	4	6	25
Central Provinces	63	117	8	10	78	276	274
Assam	8	4	..	..	..	12	20
Imperial Farms.							
Pusa	—	19	..	..	67	86	110
Karnal	..	13	..	..	17	30	4
Bangalore	1	24	2	2	29	58	71
Wellington	2	2	1	8	41	54	42

APPENDIX XIII.

List of Agricultural Publications in India during 1926-27.

No.	Title	Author	Where published
	GENERAL AGRICULTURE		
1	The *Agricultural Journal of India*, Vol. XXI, Parts IV, V and VI, and Vol. XXII, Parts I, II and III. Price, Re. 1-8 or 2*s.* per part. Annual subscription, Rs. 6 or 9*s.* 6*d.*	Edited by the Agricultural Adviser to the Government of India.	Government of India Central Publication Branch, Calcutta.
2	The *Journal of the Central Bureau for Animal Husbandry and Dairying in India*, Vol. I, Part I. Annual subscription, Rs. 2-8; Single copy As. 10.	Ditto	Ditto.
3	Scientific Reports of the Agricultural Research Institute, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugarcane Expert and Secretary, Sugar Bureau) for the year 1925-26. Price, Rs. 2-4 or 4*s.*	Issued by the Agricultural Research Institute, Pusa.	Ditto.
4	Review of Agricultural Operations in India, 1925-26. Price, Rs. 2-6 or 4*s.* 3*d.*	Issued by the Agricultural Adviser to the Government of India.	Ditto.
5	Sampling for Rice Yield in Bihar and Orissa. Pusa Agricultural Research Institute Bulletin No. 166. Price, As. 7 or 9*d.*	J. A. Hubback, I.C.S.	Ditto.
6	Annual Report of the Indian Central Cotton Committee, Bombay, 1925-26. Price, Rs. 2.	Issued by the Indian Central Cotton Committee, Bombay.	The Times Press, Bombay.
7	Agricultural Statistics of India, 1924-25, Vol. I. Price, Re. 1-5 or 2*s.* 3*d.*	Issued by the Department of Commercial Intelligence and Statistics, India.	Government of India Central Publication Branch, Calcutta.
8	Agricultural Statistics of India, 1924-25, Vol. II. Price, Re. 1-4 or 2*s.*	Ditto	Ditto.
9	Statistical Abstract for British India with Statistics, where available, relating to certain Indian States from 1915-16 to 1924-25. Price, Rs. 2 or 3*s.* 9*d.*	Ditto	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
10	Annual Report of the Royal Botanic Gardens and the Gardens in Calcutta and of the Lloyd Botanic Gardens, Darjeeling, for the year 1926-27. Price, As. 4 or 6*d*.	Superintendent, Royal Botanic Gardens, Calcutta.	Bengal Secretariat Book Depôt, Calcutta.
11	Report of the Botanical Survey of India for 1925-26.	Issued by the Director, Botanical Survey of India.	Government of India Central Publication Branch, Calcutta.
12	Report on the Administration of the Meteorological Department of the Government of India in 1925-26 and a Note on the Long Established Observatories of Madras and Bombay.	The Director General of Observatories.	Government of India Press, Simla.
13	The Coconut. Madras Department of Agriculture Leaflet No. 44 (English, Kanarese and Malayalam).	M. Govinda Kidavu, Deputy Director of Agriculture, Madras.	Government Press, Madras.
14	Cambodia Cotton. Madras Department of Agriculture Leaflet No. 45 (English, Tamil, Telegu and Kanarese).	Issued by the Department of Agriculture, Madras.	Ditto.
15	Season and Crop Report of the Madras Presidency for the Agricultural year 1926-27 (Fusli 1336). Price, Re. 1-5.	Ditto	Ditto.
16	A note on varieties of paddy grown on the Samalkota Experiment Station, Godavari District. Madras Department of Agriculture Leaflet No. 46. (English and Telegu.)	A. C. Edmonds, Deputy Director of Agriculture, Madras.	Ditto.
17	Villagers' Calendar, 1927-28. (Tamil, Telegu and Kanarese).	Issued by the Department of Agriculture, Madras.	Ditto.
18	Year Book, 1926, of the Department of Agriculture, Madras.	Ditto	Ditto.
19	Annual Reports of Experiment Stations, 1926-27.	Ditto	Ditto.
20	Report on the operations of the Department of Agriculture, Madras for 1926-27.	Ditto	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
21	Annual Reports of the Subordinate Officers of the Department of Agriculture, Madras for 1926-27.	Issued by the Department of Agriculture, Madras.	Government Press, Madras.
22	Annual Report of the Department of Agriculture in the Bombay Presidency for 1925-26. Price, Re. 1-12.	Issued by the Department of Agriculture, Pombay.	Government Central Press, Bombay.
23	Annual Season and Crop Report of the Bombay Presidency for 1925-26. Price, Re. 1-10.	Ditto	Ditto.
24	Some of the Promising Exotic Sugarcane Varieties of the Manjri Farm. Bombay Department of Agriculture Bulletin No. 125. Price, As. 13.	Rao Bahadur P. C. Patil, M.Sc., L.Ag., Principal, Agricultural College, Poona ; and V. G. Patwardhan, B. Ag.	Yeravda Prison Press, Poona.
25	The Treatment of Patches of inferior Tobacco in North Gujarat. Bombay Department of Agriculture Bulletin No. 129. Price, As. 1½.	Dr. Harold H. Mann, Director of Agriculture, Bombay ; M. L. Patel, M.Ag., and V. M. Majumdar, B.Ag.	Ditto.
26	Some useful Forest Trees and Shrubs of the Coastal Tract and their Fodder Value. Bombay Department of Agriculture Bulletin No. 130. Price, As. 8.	M. S. Tuggerse . .	Government Central Press, Bombay.
27	The Fig Industry in Asia Minor. Bombay Department of Agriculture Bulletin No. 131 of 1926. Price, As. 4-6.	Dr. G. S. Cheema, Horticulturist to Government, Bombay.	Government Central Press, Bombay.
28	The Improvement of Tobacco in Northern Gujarat. Bombay Department of Agriculture Bulletin No. 132. Price, As. 4.	Dr. Harold H. Mann, Director of Agriculture, Bombay ; M. L. Patel, M.Ag., and V. M. Majumdar, B. Ag.	Yeravda Prison Press, Poona.
29	Work of the Ganeshkhind Botanical Gardens and Modi Bag Garden for the years 1921-1925. Bombay Department of Agriculture Bulletin No. 133.	Issued by the Department of Agriculture, Bombay.	Ditto.
30	Murrah Buffaloes in Sind, Bombay Department of Agriculture Bulletin No. 134 of 1927. Price, As. 2-6.	A. M. Ulvi . . .	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
31	An improved method of growing turmeric in the Deccan. Bombay Department of Agriculture Bulletin No. 135 of 1927. Price, As. 4.	H. M. Desai. . .	Yeravda Prison Press, Poona.
32	Cattle Breeding in the Bombay Presidency; Principles and Progress. Bombay Department of Agriculture Bulletin No. 136 of 1927. Price, As. 5-6.	E. J. Bruen, Live Stock Expert, Bombay.	Ditto.
33	Notes on the Lemon industry in Italy. Bombay Department of Agriculture Bulletin No. 137 of 1927. Price, As. 2.	Dr. G. S. Cheema, Horticulturist to Government, Bombay.	Ditto.
34	Lucerne as a dry crop in the Dharwar District. Bombay Department of Agriculture Leaflet No. 7 of 1926.	Issued by the Department of Agriculture, Bombay.	Ditto.
35	Breeds of cattle in the Bombay Presidency I. The Kankrej Breed of Gujarat. Bombay Department of Agriculture Leaflet No. 9 of 1926.	Ditto	Ditto.
36	Breeds of cattle in the Bombay Presidency II. The Gir Breed of cattle. Bombay Department of Agriculture Leaflet No. 10 of 1926.	Ditto	Ditto.
37	Breeds of cattle in the Bombay Presidency III. The Sindhi or Red Karachi cattle. Bombay Department of Agriculture Leaflet No. 11 of 1926.	Ditto	Ditto.
38	Tapioca cultivation in Kanara and the Konkan. Bombay Department of Agriculture Leaflet No. 12 of 1926.	Ditto	Ditto.
39	Vinegar-making. Bombay Department of Agriculture Leaflet No. 14 of 1926.	Ditto	Ditto.
40	Breeds of cattle in the Bombay Presidency IV. The Krishna Valley breed. Bombay Department of Agriculture Leaflet No. 15 of 1926.	Ditto	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
41	Breeds of cattle in the Bombay Presidency V. The Khillari breed of cattle. Bombay Department of Agriculture Leaflet No. 16 of 1926.	Issued by the Department of Agriculture, Bombay.	Yeravda Prison Press, Poona.
42	Breeds of cattle in the Bombay Presidency VI. The Amrit-Mahal breed. Bombay Department of Agriculture Leaflet No. 17 of 1926.	Ditto	Ditto.
43	Breeds of cattle in the Bombay Presidency VII. The Dangi breed. Bombay Department of Agriculture Leaflet No. 18 of 1926.	Ditto	Ditto.
44	Breeds of cattle in the Bombay Presidency VIII. The Thar Parkar breed. Bombay Department of Agriculture Leaflet No. 19 of 1926.	Ditto	Ditto.
45	How to get information from the Agricultural Department. Bombay Department of Agriculture Leaflet No. 20 of 1926.	Ditto	Ditto.
46	List of implements recommended by the Agricultural Department for Gujarat. Bombay Department of Agriculture Leaflet No. 1 of 1927.	Ditto	Ditto.
47	List of implements recommended by the Agricultural Department for the Konkan Division. Bombay Department of Agriculture Leaflet No. 2 of 1927.	Ditto	Ditto.
48	List of implements recommended by the Agricultural Department for Sind. Bombay Department of Agriculture Leaflet No. 3 of 1927.	Ditto	Ditto.
49	Chaff-cutters. Bombay Department of Agriculture Leaflet No. 4 of 1927.	Ditto	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
50	A practical system of storing farmyard manure. Bombay Department of Agriculture Leaflet No. 5 of 1927.	Issued by the Department of Agriculture, Bombay.	Yeravda Prison Press, Poona.
51	Annual Report of the Department of Agriculture, Bengal, 1925-26. Price, Rs. 6-2.	Issued by the Department of Agriculture, Bengal.	Bengal Secretariat Book Depôt, Calcutta
52	Artificial Farmyard Manure (English). Bengal Department of Agriculture Leaflet No. 1 (English and Bengali).	R. S. Finlow, B.Sc., F.I.C., Director of Agriculture, Bengal.	Sreenath Press, Dacca.
53	Paddy Seed Farm (English and Bengali).	Ditto	Ditto.
54	Monthly and Annual Rainfall Table in the Province of Bengal for 1926.	Issued by the Department of Agriculture, Bengal.	Ditto.
55	Season and Crop Report of Bengal for 1926-27. Price, Re. 1-10.	Ditto	Bengal Secretariat Book Depôt, Calcutta.
56	Report on the working of the Department of Agriculture, Central Provinces, 1925-26. Price, Re. 1.	R. G. Allan, M.A., Offg. Director of Agriculture, Central Provinces.	Government Press, Nagpur.
57	Comments on the return of expenditure of the Provincial and District Gardens in the Central Provinces and Berar for the year ending the 31st March, 1926.	Ditto	Ditto.
58	Report on Demonstration work carried out in the Northern Circle, Central Provinces, together with Reports on Seed and Demonstration Farms for the year 1925-26. Price, Re. 1-14.	J. H. Ritchie, Deputy Director of Agriculture, Northern Circle, B. L. Dubey, Extra Assistant Director, Jubbulpore, and Govind Prasad, Extra Assistant Director, Chhindwara.	Ditto
59	Report on Demonstration work carried out in the Plateau Sub-circle, Central Provinces, together with reports on Seed and Demonstration Farms, Betul and Seoni, for the year 1925-26 Price, Re. 1-7.	E. A. H. Churchill, Assistant Director of Agriculture, Chhindwara, and Govind Prasad, Extra Assistant Director, Chhindwara	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
60	Report on Demonstration work carried out in the Southern Circle, Central Provinces, together with reports on the Seed and Demonstration Farms, Waraseoni and Sindewahi and the Cattle Breeding Farm, Sindewahi, for the year 1925-26. Price, Re. 1-10.	G. K. Kelkar, Extra Assistant Director of Agriculture, Bhandara, J. C. McDougall, Deputy Director of Agriculture, Southern Circle, Nagpur, and T. K. Ghatpande, Extra Assistant Director, Wardha.	Government Press, Nagpur.
61	Report on Demonstration work carried out in the Eastern Circle, Central Provinces, together with reports on the Seed and Demonstration Farms at Chandkhuri, Bilaspur and Drug with that of Cattle Breeding stations attached thereto for the year 1925-26. Price, Rs. 2-6.	T. L. Powar, Deputy Director of Agriculture, Eastern Circle, Raipur, N. G. Bhoot, Extra Assistant Director of Agriculture, Drug, and D. R. Mohrikar, Extra Assistant Director of Agriculture, Raipur.	Ditto.
62	Report on Demonstration work carried out in the Western Circle, Central Provinces, together with reports on the Seed and Demonstration Farm and Cattle Breeding Farms of that circle for the year 1925-26, Vol. I. Price, Re. 1-6.	S. G. Mutkekar, Deputy Director of Agriculture, Western Circle, M. S. Barkar, Extra Assistant Director, Akola, and S. L. Mohammad, Extra Assistant Director, Amraoti.	Ditto.
63	Report on the District Demonstration work carried out in the Western Circle, Central Provinces, during the year 1925-26, Vol. II. Price, Re. 1-6.	S. L. Mohammad, Extra Assistant Director, Amraoti, and M. S. Barkar, Extra Assistant Director, Akola.	Ditto.
64	Annual Reports on Experimental Farm, Akola, and the Experimental Farm attached to the Agricultural College, Nagpur, for the year 1925-26. Price, Re. 1-10.	R. H. Hill, Offg. Economic Botanist for Cotton, C. P., and H. E. Annett, Offg. Principal, Agricultural College, Nagpur.	Ditto.
65	Annual Reports on Experimental Farms of the Southern and Eastern Circles, Central Provinces, *viz.*, Tharsa and Raipur for the year 1925-26. Price, Re. 1-8.	J. C. McDougall, Deputy Director of Agriculture, Southern Circle, Nagpur, and T. L. Powar, Deputy Director of Agriculture, Eastern Circle, Raipur.	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
66	Annual Reports on Experimental Farms of the Northern and Plateau Circles, Central Provinces, Powarkhera, Adhartal, Chhindwara, with that of Cattle Breeding Stations attached thereto for the year 1925-26. Price, Rs. 2-5.	J. H. Ritchie, Deputy Director of Agriculture, Northern Circle.	Government Press, Nagpur.
67	Report on the Cattle Breeding Operations in the Central Provinces and Berar for the year 1925-26.	S. T. D. Wallace, Deputy Director in Charge, Animal Husbandry, Central Provinces.	Ditto.
68	Report on the Agricultural College, Nagpur, Chemical, Botanical, Mycological, Entomological Research, Agricultural Engineer's Section and Maharajbagh Menagerie, 1925-26. Price, Re. 1-5.	H. E. Annett, Offg. Principal, Agricultural College; H. E. Annett, Agricultural Chemist; R. H. Hill, Offg. Economic Botanist for Cotton and D. N. Matha, Second Economic Botanist; J. F. Dastur, Mycologist; J. L Khare, Entomological Assistant; H. P. Chitari, Assistant to Agricultural Engineer; H. E. Annett, Offg. Principal, Agricultural College.	Ditto.
69	Season and Crop Report of the Central Provinces and Berar for the year 1925-26. Price, Rs. 3-10.	Issued by the Department of Land Records, Central Provinces.	Ditto.
70	Annual Report of the Department of Agriculture, Bihar and Orissa, for 1925-26.	Issued by the Department of Agriculture, Bihar and Orissa.	Government Printing, Bihar and Orissa, Gulzarbagh.
71	Agricultural Statistics of Bihar and Orissa, 1925-26.	Ditto . .	Ditto.
72	Season and Crop Report of Bihar and Orissa, 1926-27. Price, Rs. 2-4.	Ditto . .	Ditto.
73	Report on Cattle Census of Bihar and Orissa, held in 1925.	Ditto . .	Ditto.
74	Manual of Records and Accounts for Farms and Offices.	Ditto . .	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
75	Leaflet on Ammophos . .	Issued by the Department of Agriculture, Bihar and Orissa.	United Press Ltd., Bhagalpur.
76	Annual Report on the Administration of the Department of Agriculture, United Provinces, for the year ending 30th June, 1927.	Issued by the Department of Agriculture, United Provinces.	Government Press, Allahabad.
77	Report on the Agricultural Stations of Central Circle, Cawnpore, United Provinces, for the year ending 30th June, 1926.	Ditto . .	Ditto.
78	Report on the Agricultural Stations of Western Circle, United Provinces, for the year ending 30th June, 1926.	Ditto . .	Ditto.
79	Combined Report on the Experimental Stations in the Eastern Circle, United Provinces, in the year ending 31st May, 1926.	Ditto . .	Ditto.
80	Report on the Agricultural Stations of the North-Eastern Circle, United Provinces, for the year ending 30th June, 1926.	Ditto . .	Ditto.
81	Report on the Agricultural Stations in the Rohilkhand Circle, United Provinces, for the year ending 30th June, 1926.	Ditto . .	Ditto.
82	Report on the Agricultural Stations in the Bundelkhand Circle, United Provinces, for the year ending 30th June, 1926.	Ditto . .	Ditto.
83	Report on the Working and Administration of the United Provinces Government Gardens for the year ending 30th June, 1926.	Ditto . .	Ditto.
84	Maintenance of Purity of the improved cottons.	B. Ram Prasad, Assistant Economic Botanist to Government, United Provinces, Cawnpore.	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
85	A note on Water Hyacinth in the United Provinces.	R. L. Sethi, Economic Botanist to Government, United Provinces, Cawnpore.	Government Press Allahabad.
86	Reboisement des Zones Arides de la Colline de, Delhi.	A. E. P. Griessen .	Ditto.
87	Deux Types de machine a tranplanter.	Ditto . .	Ditto.
88	Seasonal variations in the Nitrate content of soils.	H. N. Batham, Offg. Agricultural Chemist, U.P.	Ditto.
89	Pamphlet on groundnuts (Hindi and Urdu).	Rai Sahib Pt. Nand Kishore Sharma.	Ditto.
90	Pamphlet on Zira (Hindi and Urdu).	Ditto . .	Ditto.
91	Pamphlet on Maize (Hindi and Urdu).	Ditto . .	Ditto.
92	Advancement of Agriculture (*i.e.*, Zaraiti Tarriqiyat, in Urdu).	Pandit Tej Shankar Kochak.	Ditto.
93	Practical guide to Oil Engines	R. C. Agarwal . .	Ditto.
94	Agricultural Reader, (*i.e.*, Zaraiti Reader, Part II, in Urdu).	D. D. Sharma . .	Ditto.
95	Cattle Disease and its treatment (*i.e.*, Janwaron ki bimari aur uska ilaj, in Urdu).	Ditto . .	Ditto.
96	Season and Crop Report of the United Provinces of Agra and Oudh for the year 1926-27. Price, Re. 1-14.	Issued by the Department of Land Records, United Provinces.	Ditto.
97	Annual Report of the Department of Agriculture, Punjab, for 1925-26.	Issued by the Department of Agriculture, Punjab.	Government Printing Punjab, Lahore.
98	Annual Report of the Lawrence Gardens, Lahore, for 1925-26.	Ditto . .	Ditto.
99	Prospectus of the Punjab Agricultural College, Lyallpur, for 1927.	Ditto . .	Ditto.
100	Seasonal Notes (October 1926 and April 1927).	Ditto . .	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
101	Harmful effects of close planting, various methods of laying out of gardens, distance necessary for fruit trees.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
102	Heading back of young nursery trees.	Ditto . .	Ditto.
103	Hints on the management of sheep in the Punjab.	Ditto . .	Ditto.
104	The Hatching of eggs by Natural methods.	Ditto . .	Ditto.
105	Study of soils for Fruit Gardens	Ditto . .	Ditto.
106	The rearing, feeding and diseases of chicks and young poultry.	Ditto . .	Ditto.
107	Protecting trees from sunburnt	Ditto . .	Ditto.
108	Cattle and Dairying in the Punjab (Reprinted).	A. M. Stow . . .	Ditto.
109	Season and Crop Report of the Punjab, 1925-26. Price, Rs. 3-12.	Issued by the Department of Agriculture, Punjab.	Ditto.
110	Tables of Agricultural Statistics of the Punjab, 1925-26.	Ditto . .	Ditto.
111	Part II of the Report on the Operations of the Department of Agriculture, Punjab, for the year ending 30th June, 1925.	Ditto . .	Ditto
112	Notes on the harvest of cane and manufacture of *gur*.	Malik Sultan Ali, Deputy Director of Agriculture, Gurdaspur.	Ditto.
113	Report on the Economic Position of the Sugarcane Crop in the Punjab.	Ch. Mohd. Abdullah, Deputy Director of Agriculture, Multan.	Ditto.
114	Report on the Operations of the Department of Agriculture, Burma, for the year ended 30th June, 1926.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
115	Report on the Mandalay Agricultural Station, Burma, for the year ended 30th June, 1926.	Ditto . .	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
116	Report on the Mahlaing Agricultural Station, Burma, for the year ended 30th June, 1926.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
117	Report on the Padu Agricultural Station, Burma, for the year ended 30th June, 1926.	Ditto . .	Ditto.
118	Annual Report of Principal, Agricultural College, Mandalay, for 1926.	Ditto . .	Ditto.
119	Agricultural leaflets in book form in two volumes.	Ditto . .	Ditto.
120	Report on the Hmawbi Agricultural Station, Burma, for the year ended 30th June, 1926.	Ditto . .	Ditto.
121	Report on the Tatkon Agricultural Station, Burma, for the year ended 30th June, 1926.	Ditto . .	Ditto.
122	Report of the Agricultural Engineer, Burma, for the year ended 30th June, 1926.	Ditto . .	Ditto.
123	Report on the Pwinbyu Seed Farm, Burma, for the year ended 30th June, 1926.	Ditto . .	Ditto.
124	Report on Sericulture, Burma, for the year ended 30th June 1926.	Ditto . .	Ditto.
125	Combined Report of Akyab Agricultural Station and Kyaukpyu Coconut Farm, Burma, for the year ended 30th June, 1926.	Ditto . .	Ditto.
126	Economic Survey of the Sugarcane Industry in the East Central, Tenasserim and Northern Agricultural Circles, Burma, for the year ended 30th June, 1926.	Ditto . .	Ditto.
127	Report on the Flora of the Agricultural College Station, Mandalay.	A. M. Sawyer, Assistant Director, Burma.	Ditto.
128	Agricultural Statistics of Burma, for the year 1925-26. Price, Rs. 2 or 3*s*.	Commissioner of Settlements and Land Records, Burma.	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
129	Season and Crop Report of Burma for the year ending 30th June 1927. Price, Re. 1.	Commissioner of Settlements and Land Records, Burma.	Government Printing Burma, Rangoon.
130	Report of the Department of Agriculture, Assam, for the year ending 31st March, 1926.	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.
131	Practical Suggestion to Orange Growers. Assam Department of Agriculture Leaflet No. 1 (Bengali, Assamese, Khasi).	Ditto . .	Ditto.
132	Leaf curl in Litchi. Assam Department of Agriculture Leaflet No. 2.	Ditto . .	Ditto.
133	Vegetable Seeds. Assam Department of Agriculture Leaflet No. 3.	Ditto . .	Ditto.
134	Humus in Assam Soil; its depletion and means of Recuperation. Assam Department of Agriculture Bulletin No. 1.	Ditto . .	Ditto.
135	Report of the Agricultural Stations at Tarnab and Haripur in the North-West Frontier Province, 1925-26. Price, As. 13.	W. Robertson Brown, Agricultural Officer, North-West Frontier Province.	North-West Frontier Province Government Printing and Stationery Office, Peshawar.
136	Summary of Remarks on the Kharif Crop of the North-West Frontier Province for 1926-27. Price, As. 8.	Revenue Commissioner, North-West Frontier Province.	Ditto.
137	Report on the Season and Crops of the North-West Frontier Province for the year 1925-26. Price, Rs. 2-3.	Ditto . .	Ditto.
138	Report on the Administration of the Village Panchayats and Department of Agriculture in the Cochin State for the year 1925-26.	Superintendent of Agriculture and Panchayats, Trichur.	Government Press, Cochin, Ernakulam.
139	Annual Report of the Departments of Agriculture and Agricultural Engineering, Gwalior Government, 1925-26.	Issued by the Department of Agriculture, Gwalior.	Alijah Darbar Press, Lashkar.
140	Annual Report of the Agricultural Department, Mysore, for the year 1925-26.	Issued by the Department of Agriculture, Mysore.	Government Press, Bangalore.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
141	Report on the working of the Amrit Mahal Department, Mysore, 1925-26.	Issued by the Department of Agriculture, Mysore.	Government Press, Bangalore.
142	Mysore Agricultural Calendar, 1927. Price, As. 2.	Ditto . .	Ditto.
143	Report of work done in the Department of Sericulture in Mysore, during 1925-26.	Ditto . .	Ditto.
144	Annual Report of the Department of Agriculture, Baroda State, for the year 1924-25. Price, Re. 1-6.	Issued by the Department of Agriculture, Baroda.	Baroda State Press, Baroda.
145	Annual Report of the Department of Agriculture and Fisheries, Government of Travancore, 1926.	Issued by the Director of Agriculture and Fisheries, Travancore.	Travancore State Press, Trivandrum.
146	*Quarterly Journal of the Indian Tea Association.* Price, As. 6 per copy.	Scientific Department of the Indian Tea Association, Calcutta.	Calcutta Orphan Press, Calcutta.
147	*Indian Scientific Agriculturist* (Monthly). Annual subscription, Rs. 4.	H. C. Sturgess, Editor, J. W. McKay, A.R.C.Sc., N.D.A., Consulting Editor.	Calcutta Chromotype Company, 52-53, Bow Bazar Street, Calcutta.
148	*Rural India* (Monthly). Single As. 6, Annual subscription, Rs. 3.	A. Swaminatha Ayyar .	President, Forest Panchayat, Banking Union, Madras.
149	The *Journal of the Mysore Agricultural and Experimental Union* (Quarterly). Annual subscription, Rs. 3.	Mysore Agricultural and Experimental Union.	Bangalore Press, Bangalore.
150	The *Journal of the Madras Agricultural Students' Union* (Monthly). Annual subscription, Rs. 4; single copy As. 6.	Madras Agricultural Students' Union.	The Electric Printing Works, Coimbatore.
151	The *Planters' Chronicle* (Weekly)	Issued by the United Planters' Association of South India.	Diocesan Press, Post Box 455, Madras.
152	Annual Report of the Rubber Specialist, U. P. A. of South India, for 1926-27.	Ditto . .	"The Madras Mail" Press, Madras.
153	Administration Report of the Tea Scientific Officer, U. P. A. of South India, for 1926-27.	Ditto . .	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	GENERAL AGRICULTURE —*contd.*		
154	Administration Report of the General Scientific Officer, U. P. A. of South India, for 1926-27.	Issued by the United Planters' Association of South India.	"The Madras Mail" Press, Madras.
155	Report on the Saidapur Coffee Experimental Station, U. P. A. of South India, 1926-27.	Ditto . .	Ditto.
156	The *Nagpur Agricultural College Magazine* (Quarterly). Annual subscription, Rs. 3.	R. A. Ramayyar, and R. B. Ekbote, Editors.	Udyama Desha Sevak Press, Nagpur.
157	*Poona Agricultural College Magazine* (Quarterly). Annual subscription Rs. 2-8; single copy, As. 10.	College Magazine Committee, Poona.	Agricultural College, Poona.
158	The *Old Boys' Magazine, Agricultural College, Cawnpore* (Quarterly). Price, As. 8 per copy; Annual subscription, Rs. 2.	L. Saksena, L.Ag., Editor.	Cawnpore Printing Press.
159	The *Allahabad Farmer* (Quarterly). Single copy, As. 8; per year Rs. 2.	W. R. Hayes, E. W. Jeremy, J. N. Shivpuri.	The Mission Press, Allahabad.
160	The *Bengal Agricultural Journal* (Quarterly). (In English and Bengali.) Annual subscription, Re. 1-4, Single copy, As. 5.	Issued by the Department of Agriculture, Bengal.	Sreenath Press, Dacca.
	AGRICULTURAL CHEMISTRY		
161	A Study of Absorption of Moisture by Soils. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. VIII, No. 12. Price, As. 6 or 9*d*.	J. Sen, M.A., Ph.D., Biochemist, Forest Research Institute, Dehra Dun, and Bhailal M. Amin, B.A.	Government of India Central Publication Branch, Calcutta.
162	The Selection of Burma Beans (*Phaseolus lunatus*) for Low Prussic Acid Content. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. IX, No. 1. Price, As. 10 or 1*s*.	J. Charlton, M.Sc., F.I.C., Agricultural Chemist, Burma.	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	AGRICULTURAL CHEMISTRY —*concld.*		
163	Bangalore Maintenance Experiments, First Series. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. IX, No. 2. Price, As. 11 or 1*s.* 2*d.*	F. J. Warth, M.Sc., Physiological Chemist, Imperial Institute of Animal Husbandry and Dairying, Bangalore.	Government of India Central Publication Branch, Calcutta.
164	Some Digestibility Trials on Indian Feeding Stuffs, II. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. IX, No. 3, Price, As. 10 or 1*s.*	P. E. Lander, M.A.,D.Sc., A.I.C., Agricultural Chemist, Punjab, and Pandit Lal Chand Dharmani, L.Ag., B.Sc. (Ag.).	Ditto.
165	The Effect of Manuring crop on the Vegetative and Reproductive capacity of the Seed. Memoirs of the Department of Agriculture in India, Chemical Series, Vol. IX, No. 4. Price, As. 14 or 1*s.* 6*d.*	B. Viswanath, F.I.C., Government Agricultural Chemist, Madras, and N. Surianarayana, B.Sc.	Ditto.
166	Report of the Agricultural Chemist, Burma, for the year ended 30th June, 1926.	Issued by the Department of Agriculture, Burma.	Government Printing, Burma, Rangoon.
	BOTANY		
167	Sugarcane Breeding—Indications of Inheritance. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIV, No. 3. Price, As. 8 or 10*d.*	Rao Saheb T. S. Venkatraman, B.A., Government Sugarcane Expert, Coimbatore.	Government of India Central Publication Branch, Calcutta.
168	Studies in Gujarat Cottons, Part IV: Hybrids between Broach-deshi and Goghari varieties of *Gossypium herbaceum.* Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIV, No. 4. Price, As. 14 or 1*s.* 6*d.*	M. L. Patel, M.Ag., Cotton Breeder, South Gujarat, and S. J. Patel, B.Ag.	Ditto.
169	The indigenous Cotton types of Burma. Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIV, No. 5. Price, As. 9 or 10*d.*	T. D. Stock, B.Sc., D.I.C., A.R.C.S., Deputy Director of Agriculture, Burma.	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	BOTANY—*concld.*		
170	A Study of *Fusaria* common to cotton plants and cotton soils in the Central Provinces, Memoirs of the Department of Agriculture in India, Botanical Series, Vol. XIV, No. 6. Price, As. 5 or 6*d*.	Jiwan Singh, M.Sc.	Government of India Central Publication Branch, Calcutta.
171	A Scheme of Classification of the Varieties of Rice found in Burma. Pusa Agricultural Research Institute Bulletin No. 167. Price, As. 6 or 8*d*.	R. A. Beale	Ditto.
172	The classified list of the plants of Burma.	A. M. Sawyer and Daw Nyun.	Government Printing, Burma, Rangoon.
173	Report of the Economic Botanist, Burma, for the year ended 30th June, 1926.	Issued by the Department of Agriculture, Burma.	Ditto.
174	Flora of Indus Delta	T. S. Sabnis, M. Sc., Second Economic Botanist, U. P.	Government Press, Allahabad.
	MYCOLOGY		
175	The Mosaic Disease of Sugarcane. Madras Department of Agriculture Leaflet No. 42 (English, Tamil, Telegu, Malayalam and Kanarese).	S. Sundararaman, M.A., Government Mycologist, Coimbatore.	Government Press, Madras.
176	The Diseases of Para Rubber in Burma.	D. Rhind, B.Sc., Mycologist to Government, Burma.	Government Printing, Burma, Rangoon.
177	Report of the Mycologist, Burma, for the year ended 30th June, 1926.	Ditto	Ditto.
178	Treatment of Gum Disease of Mosambi Plants. Bombay Department of Agriculture Leaflet No. 8 of 1926.	Issued by the Department of Agriculture, Bombay.	Yeravda Prison Press, Poona.
179	Remedies for Kolerogo disease of betelnuts. Bombay Department of Agriculture Leaflet No. 13 of 1926.	Ditto	Ditto.
180	Control of the powdery mildew of grapes. Bombay Department of Agriculture Leaflet No. 6 of 1927.	Ditto	Ditto.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	ENTOMOLOGY		
181	The Katra or Hairy Caterpillar of Gujarat. Bombay Department of Agriculture Leaflet No. 4 of 1926.	Issued by the Department of Agriculture, Bombay.	Yeravda Prison Press, Poona.
182	Studies on Indian Thysanoptera. Memoirs of the Department of Agriculture in India, Entomological Series, Vol. IX, No. 6. Price, Re. 1-8 or 2*s.* 6*d.*	Dr. H. H. Karny .	Government of India Central Publication Branch, Calcutta.
183	New Species of Indian Gall Midges (*Itonididæ*).	E. P. Felt . . .	Ditto.
	New Indian Geometridæ . .	Lewis B. Prout, F.E.S. .	Ditto.
	Description of *Lasiopresia stirpicola*, n. sp. (Lepidoptera) with	E. Meyrick, F.R.S. .	Ditto.
	A short note on the Life history and status. Memoirs of the Department of Agriculture in India, Entomological Series, Vol. IX, Nos. 7 to 9. Price, As. 5 or 6*d.*	Rao Bahadur C. S. Misra, B.A.	Ditto.
184	Some New Indian Miridæ (Capsidæ). Memoirs of the Department of Agriculture in India, Entomological Series, Vol. X, No. 4. Price, As. 6 or 8*d.*	E. Ballard, B.A., F.E.S.	Ditto.
185	List of Publications on Indian Entomology. Pusa Agricultural Research Institute Bulletin No 165.	Compiled by the Imperial Entomologist and the Officiating Imperial Entomologist, Pusa.	Ditto
186	The Catalogue of Indian Insects. Part 11, Bronthidæ. Price, Re. 1-2 or 2*s.*	Richard Kleine . .	Ditto
187	The Catalogue of Indian Insects, Part 12, Tabanidae, Price, Re. 1-12 or 3*s.*	Ronald Senior-White, F. E. S., F. R. S., T. M. &. H.	Ditto.
188	Jute Semi-Looper. Assam Department of Agriculture Leaflet No. 4 (English, Assamese and Bengali).	Issued by the Department of Agriculture, Assam.	Assam Secretariat Printing Office, Shillong.

List of Agricultural Publications in India during 1926-27—contd.

No.	Title	Author	Where published
	VETERINARY		
189	Experiments on the treatment of Hookworm Infection in Dogs. Memoirs of the Department of Agriculture in India, Veterinary Series, Vol. III, No. 7. Price, As. 11 or 1s. 3d.	Amarnath Gulati, M.Sc., Imperial Institute of Veterinary Research, Muktesar.	Government of India Central Publication Branch, Calcutta.
190	On the Occurrence of a Lung Fluke *Paragonimus edwardsi*, n. sp. in a Palm Civet (*Paradoxurus grayi*) in Kumaun Hills.	Ditto	Ditto.
191	On the Occurrence of *Isospora* and *Balantidium* in Cattle. Memoirs of the Department of Agriculture in India, Veterinary Series, Vol. III, Nos. 8 and 9.	H. Cooper, M.R.C.V.S., and Amarnath Gulati, M.Sc., Imperial Institute of Veterinary Research, Muktesar.	Ditto.
192	Annual Administration Report of the Civil Veterinary Department, Madras, for 1925-26. Price, As. 12.	Veterinary Adviser to the Government of Madras.	Government Press, Madras.
193	Annual Administration Report of the Bombay Veterinary College, Bombay City and Harbour Veterinary Department and Civil Veterinary Department in the Bombay Presidency (including Sind) for 1925-26. Price, Re. 0-14-6 or 1s. 6d.	Issued by the Civil Veterinary Department, Bombay.	Government Central Press, Bombay.
194	Annual Report of the Civil Veterinary Department, Bihar and Orissa, for 1925-26. Price, Re. 1-6.	Diretor, Civil Veterinary Department, Bihar and Orissa.	Government Printing, Bihar and Orissa.
195	Annual Report of the Civil Veterinary Department, United Provinces, for the year ending 31st March, 1926. Price, Re. 1-14.	Issued by the Civil Veterinary Department, United Provinces.	Government Press, United Provinces, Allahabad.
196	Report of the Civil Veterinary Department of the Central Provinces and Berar during the year 1925-26. Price, Re. 1-10.	Issued by the Civil Veterinary Department, Central Provinces and Berar.	Government Press, Central Provinces, Nagpur.
197	Report of the Civil Veterinary Department, Assam, for 1925-26. Price, As. 8 or 9d.	Issued by the Civil Veterinary Department, Assam.	Assam Secretariat Printing Office, Shillong.

List of Agricultural Pubications in India during 1926-27—concld.

No.	Title	Author	Where published
	VETERINARY—*concld.*		
198	Report of the Civil Veterinary Department, Burma (including the Insein Veterinary School) for the year ended the 31st March, 1926. Price, Re. 1-4 or 1*s.* 11*d.*	Issued by the Civil Veterinary Department, Burma.	Government Printing, Burma, Rangoon.
199	Annual Administration Report of the Civil Veterinary Department, North-West Frontier Province, for 1925-26. Price, Re. 1-3.	Issued by the Civil Veterinary Department, North-West Frontier Province.	North-West Frontier Province Government Press, Peshawar.
200	Annual Report on the Punjab Veterinary College, Civil Veterinary Department and Government Cattle Farm, Hissar.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
201	Annual Report of the Camel Specialist, Sohawa.	Ditto	Ditto.
202	Prospectus of the Punjab Veterinary College, Lahore, for 1927.	Ditto	Ditto.
203	The *Indian Veterinary Journal* (quarterly). Annual subscription, Rs. 4 for members of All India Veterinary Association and Students; Rs. 8 for others.	P. Srinivasa Rao, G. M. V. C., Editor.	Methodist Publishing House, Madras.
204	List of Horses and Cattle Fairs in the Punjab.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
205	Surra Transmission Experiments	S. Kahan Singh, Officer in charge of the Office of the Camel Specialist, Sohawa (Jhelum).	Ditto.

00134283

Digitized with financial assistance from

Government of Maharashtra

on 01 February, 2020